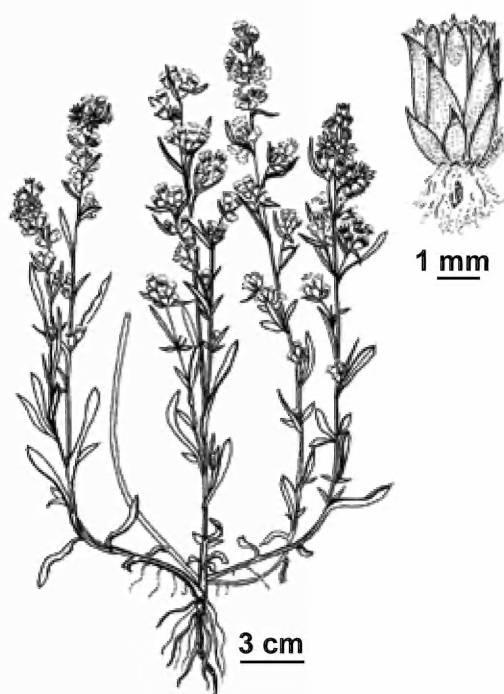
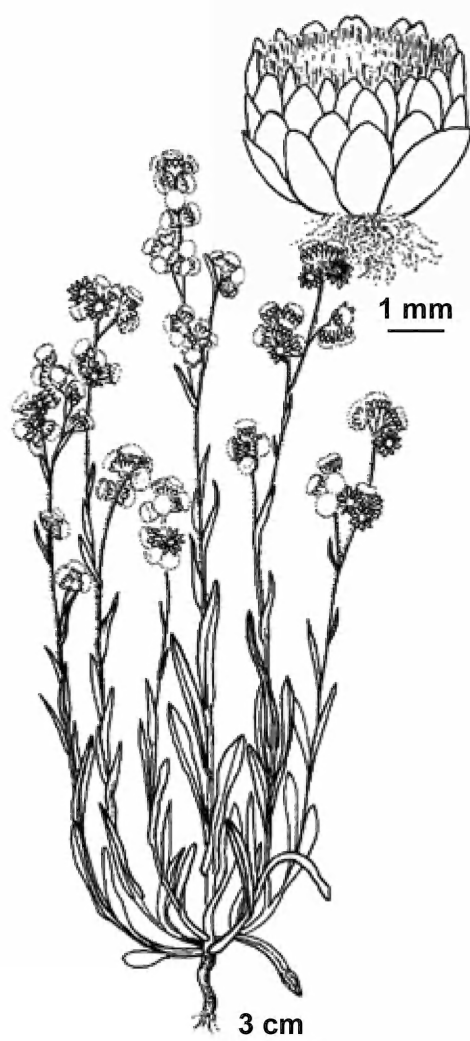


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Left: *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L.Burt, *Bot. J. Linn. Soc.* 82: 206 (1981). Above: *Gamochaeta calviceps* (Fernald) Cabrera, *Bol. Soc. Argent. Bot.* 9: 368 (1961).

Source: State Botanical Collection

Illustrations: E. Mayfield

These illustrations were prepared for the *Flora of Victoria* by Enid Mayfield, botanical artist, who contributed a large number of illustrations to volumes III and IV of the flora.

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New combinations in the lichen genus *Tasmidella*

Gintaras Kantvilas

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Introduction

The genus *Tasmidella* Kantvilas, Hafellner & Elix was introduced by Kantvilas *et al.* (1999) to accommodate Tasmanian crustose lichens with an ecorticate thallus, a chlorococcoid photobiont, biatorine apothecia with an annular proper exciple composed of prosenchymatous hyphae densely interspersed with oil droplets, simple, non-capitate paraphyses, 8-spored asci with a well-developed, amyloid tholus penetrated by a non-amyloid *masse axiale* with convergent flanks, 0(–1)-septate, hyaline ascospores with a distinctly two-layered wall, and filiform conidia. This combination of characters serves to distinguish *Tasmidella* from several, superficially similar genera, notably *Megalaria* Hafellner, *Lecidella* Körb. and *Ramboldia* Kantvilas & Elix (see Kantvilas *et al.* 1995 for a tabular comparison) and *Japewiella* Printzen (Printzen 1999). The genus was described as monotypic, with two varieties distinguished chiefly by their chemical constituents, and was classified, together with *Megalaria*, in the Megalariaceae. Subsequently Jaklitsch *et al.* (2016) placed it (and *Megalaria*) in the Ramalinaceae, together with, for example, *Bacidia* De Not., *Japewia* Tønsberg, *Frutidella* Kalb and numerous other crustose genera that occur in cool temperate Australia (see McCarthy 2023). This classification was maintained by Lucking *et al.* (2016) although Kistenich

Abstract

The lichen genus *Tasmidella* was initially described as monotypic, with two chemically-defined varieties. It is now found to comprise two species: *T. inactiva* (Kantvilas *et al.*) Kantvilas, *stat. nov.*, containing atranorin only, and *T. subfuscescens* (Hellb.) Kantvilas, *comb. nov.*, containing xanthonones only, with the synonyms *T. variabilis* Kantvilas *et al.* var. *variabilis* and *Lecidea dracophylli* Zahlbr. The former is recorded from Tasmania and New Zealand; the latter occurs in Tasmania, Victoria and New Zealand and is lectotypified. Salient features of *Tasmidella* and several superficially similar genera are compared.

Keywords: Australia, Bacidiaceae, lichenised Ascomycetes, Megalariaceae, New Zealand, Tasmania, Victoria

et al. (2018) explicitly exclude *Tasmidella* from the Ramalinaceae and associate it with the Lecanoraceae.

Since its first description, specimens of *Tasmidella* have continued to be added to herbaria, indicating that it is ecologically and geographically more widespread than initially thought. These additional collections have also led to a reappraisal of the status of the two varieties, whereas the ongoing study of Australasian type specimens in European herbaria has unearthed an older name for the type species. The necessary taxonomic and nomenclatural adjustments are addressed in the present paper.

Materials and methods

The study is based mainly on specimens housed in the Tasmanian Herbarium (HO) and on field observations by the author. Morphological and anatomical investigations were undertaken on hand-cut sections of the thallus and apothecia, using standard methods, reagents and stains: water, 10% KOH (K), Lactophenol Cotton Blue and Lugol's Iodine (I). Amyloid reactions of the asci were undertaken on apothecial sections pretreated in K, rinsed in water and then mounted in I. Measurements of ascospores are presented in the format 5th percentile–average–95th percentile, with outlying values in brackets and *n* indicating the number of observations. Routine chemical analyses were undertaken by thin-layer chromatography following standard methods (Orange *et al.* 2010), using solvents A and C; *Lecidella flavovirens* Kantvilas & Elix was used as the reference for thiophanic acid. Nomenclature of pigments follows Meyer & Printzen (2000) and Kantvilas (2009).

Taxonomy

Tasmidella inactiva (Kantvilas, Hafellner & Elix) Kantvilas, stat. nov.

Mycobank No. MB851223

Tasmidella variabilis var. *inactiva* Kantvilas, Hafellner & Elix, *Lichenologist* 31: 220 (1999).

Type: Australia, Tasmania, Hartz Mountains National Park, Lake Osborne Track, 43°13'S 146°45'E, on *Nothofagus cunninghamii* in subalpine woodland, 820 m, 9 August 1981, G. Kantvilas 488/81 & P. James (holo—HO!; iso—BML, GZU!).

Thallus smooth, rimose-areolate to weakly verruculose, pale cream or grey, to 250 µm thick but frequently much thinner, esorediate, forming diffuse patches to c. 5 cm wide; prothallus usually present, effuse, bluish black, visible at the thallus periphery or where the thallus is thin or discontinuous; photobiont with globose cells 6–13 µm wide. **Apothecia** 0.5–1.5(–2) mm wide, sessile, basally constricted; disc most commonly black to grey-black, thinly bluish grey-pruinose, sometimes pale brownish and epruinose, occasionally piebald, usually plane, or becoming undulate to convex; proper exciple prominent and persistent, glossy black, in section 70–120 µm thick laterally, blue-green K+ olive-green, N+ crimson (*cinereorufa*-green) at the upper edge, brownish at the sides, becoming dilutely pigmented to hyaline within, sometimes with traces of additional violet, K+ vivid turquoise pigment (*fucatus*-violet), composed of prosenchymatous, radiating, branched and anastomosed hyphae to 2 µm wide, densely interspersed with oil droplets to 20 µm wide; pigments deposited between (and not within) the hyphae. **Hypothecium** hyaline to pale yellowish, often patchily I+ violet, 90–200 µm thick, densely interspersed with oil droplets. **Hymenium** 60–100 µm thick, hyaline, not interspersed, bluish green, K+ olive-green, N+ crimson in the uppermost part and overlain by a layer of angular crystals that do not dissolve in K; paraphyses (1–)1.5–2 µm thick, separating easily in K, with apices generally unthickened or to 2–2.5 µm wide; asci 50–70 x 15–30 µm. **Ascospores** straight or occasionally slightly curved, ellipsoid to slightly oblong, (12–)13.5–16.4–20(–22.5) x 7–8.0–10 µm (*n* = 60); wall 1–1.5 µm thick. **Pycnidia** not found. **Chemical composition:** atranorin and chloroatranorin; thallus K+ yellowish, KC–, C–, P–, UV–. (Figure 1)

Remarks: With respect to its apothecial anatomy and ascospore size, this species is identical to *T. subfuscescens* (= *T. variabilis* var. *variabilis*) (see below) and was initially described at varietal rank on the basis of its different chemical composition, with the latter taxon containing xanthones but lacking atranorin (Kantvilas *et al.* 1999). This difference is significant in that atranorin and xanthones arise by biosynthetically unrelated chemical pathways (Elix 1996). In the years since their first description, both taxa have been observed and collected frequently, and their separation at first



Figure 1. *Tasmidella inactiva* habit (holotype). Scale = 2 mm.
Photo: J. Jarman.

glance (without the aid of chemical analysis) has rarely posed a problem. *Tasmidella inactiva* has a pale greyish (rather than distinctly yellowish) thallus, its apothecial disc is commonly pruinose (but only rarely so in *T. subfuscescens*) and also tends to be persistently plane and marginate (whereas in *T. subfuscescens* the disc frequently becomes convex and the margin is excluded (see Figs 1–2). This combination of chemical and morphological distinguishing characters make it worthy of species rank. The original description of *T. inactiva* was based solely on the differentiating chemical character. For completeness, a comprehensive morphological and anatomical description is provided here.

Tasmidella inactiva is known from Tasmania and New Zealand, where it occurs as an epiphyte on the smooth bark of young trees in high-elevation rainforest and subalpine woodland and scrub. The grey thallus and thinly marginate, lightly pruinose apothecia are very distinctive. Although *T. subfuscescens* frequently occurs at the same localities, the two species are rarely sympatric.

Selected specimens examined: AUSTRALIA, TASMANIA: Weindorfers Forest, 41°38'S 145°56'E, 30.iii.1988, G. Kantvilas s.n. (HO); Anthony Road, 41°50'S 145°38'E, 560 m, 16.xii.1988, G. Kantvilas 575/88 (GZU, HO); Little Fisher River, 41°45'S 146°20'E,

850 m, 3.xi.1991, G. Kantvilas 347/91, B. Fuhrer & J. Jarman (HO); Pelion Plains, 1 km W of Pelion Hut, 41°50'S 146°02'E, 900 m, 12.iii.1992, G. Kantvilas 222/92 (GZU, HO); The Gap, Florentine Road, 42°43'S 146°29'E, 600 m, 1997, G. Kantvilas 266/97 (HO, MSC); Lots Wife, 42°57'S 146°28'E, 1070 m, 4.xii.2000, G. Kantvilas 469/00 (HO); northern shore of Lake Adelaide, 41°50'S 146°15'E, 1060 m, 3.ii.2002, G. Kantvilas 69/02 (HO); track from Twilight Tarn to Lake Webster, 42°39'S 146°35'E, 950 m, 8.iii.2021, G. Kantvilas 73/21 (HO); Lake Skinner, along banks of outlet creek, 42°56'S 146°41'E, 960 m, 3.iv.2021, G. Kantvilas 134/21 (HO). **NEW ZEALAND:** Canterbury, Craigieburn Range, Craigieburn Stream, 43°06'42"S 171°42'30"E, 1200 m, 27.xi.2010, G. Kantvilas 337/10 (CHR, HO).

***Tasmidella subfuscescens* (Hellb.) Kantvilas, comb. nov.**

Mycobank No. MB851224

Biatora subfuscescens Hellb., *Bih. Kongl. Svenska Vetensk.-Akad. Handl., Afd. 3* 21 (no. 13): 104 (1896); *Lecidea dracophylli* Zahlbr., *Catal. Lich. Univ.* 3: 756 (1925).

Type: New Zealand, Canterbury, Porters Pass, 1000 m, on twigs of *Dracophyllum*, February 1874, Sv. Bergrenn L5 (lectotype, here designated, S L3882!; isolecto—S3883!).

=*Tasmidella variabilis* Kantvilas, Hafellner & Elix var. *variabilis*, *Lichenologist* 31: 214 (1999).

Type: Australia, Tasmania, c. 4 km E of McPartlan Pass, 42°51'S 146°14'E, on *Banksia marginata* in open *Eucalyptus nitida*-dominated woodland, 360 m, 5 December 1995 G. Kantvilas 186/95 (holo—HO!; iso—GZU!).

A comprehensive description of this species, with anatomical illustrations is provided by Kantvilas *et al.* (1999). It is anatomically identical to *T. inactiva* but with the thallus generally coarser, more verruculose, dull yellowish and containing xanthonenes, and the apothecial disc black, pale brown or piebald, rarely pruinose, frequently becoming convex and immarginate with age, with young apothecia frequently regenerating on old, moribund apothecia. Ascospores are (13-)14–16.7–21(–22) × 6–6.9–8 µm ($n = 70$). Conidia filiform, 12–14 × 1 µm. Chemical composition: thiophanic acid, arthothelin ($\pm$ trace); thallus K-, KC-, C+ orange, P-, UV+ orange-pink. (Figure 2)

Remarks: Although Galloway (1985) seemingly lectotypified this species, he did not distinguish between two collections held in S; thus formal lectotypification is undertaken here. The annotations on Bergrenn's type

collection (including 'L5') are believed to be in the hand of Per J. Hellbom (*in litt.*, anonymous reviewer).

This species is readily distinguished macroscopically by the combination of a yellowish thallus and black to piebald or brown apothecia. The structure of the exciple, the characteristic ascus type and, in particular,

the double ascospore wall, clearly evident in high-power light microscopy, distinguish it from superficially similar crustose lichens which can occur in the same habitats; these features were illustrated by Kantvilas *et al.* (1995). The only species with a similarly yellowish thallus and bluish green apothecial pigmentation is

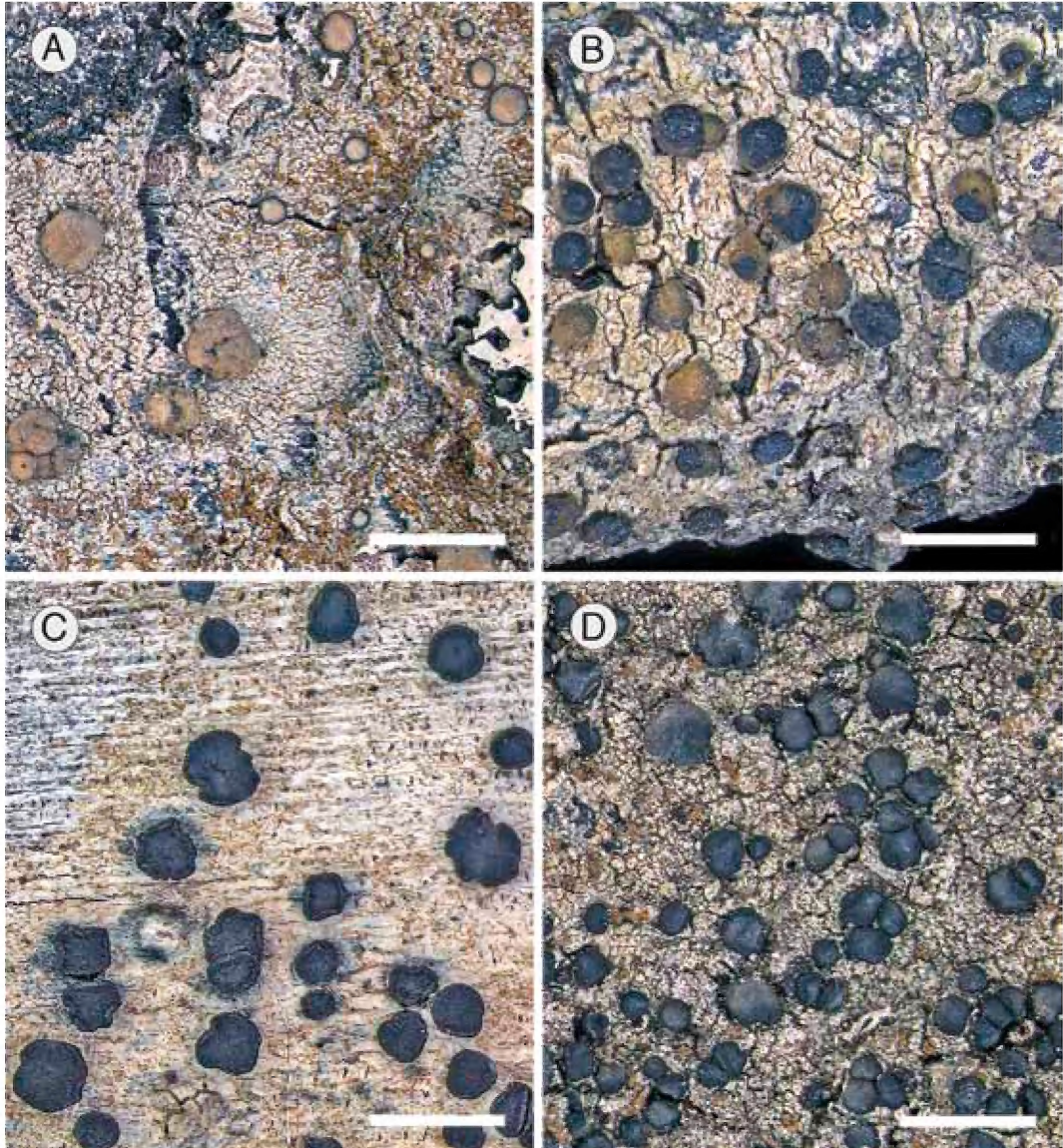


Figure 2. Variation in *Tasmidella subfuscescens*. **A.** Very pale yellowish thallus from deep shade, with apothecia with a pale brownish disc and dark margin (Kantvilas 294/90). **B.** "Typical" form from emergent *Banksia* in buttongrass moorland: verruculose, yellowish thallus with black, brown or piebald apothecia (Kantvilas 126/84). **C.** Very thin, smooth, patchy thallus with jet-black, persistently marginate apothecia with a plane disc, collected from the dead leaves of alpine *Richea pandanifolia* (Kantvilas 72/21). **D.** Coarse, verruculose, yellowish thallus with generally dark apothecia, collected from an exposed habitat (Kantvilas 28/18). Scales = 2 mm. Photos: J. Jarman.

Lecidella flavovirens, which is chemically very similar, but is sorediate, has *Lecidella*-type asci, a rather cellular, paraplectenchymatous exciple, and ascospores with an unlayered wall; this species also occurs in much drier habitats (Kantvilas & Elix 2013). The most intensely pigmented apothecia are found in the most exposed, sunniest habitats; in deep shade the apothecia are frequently flesh-coloured but nevertheless with a dark, glossy margin. Salient features of *Tasmidella*, *Lecidella* and several other crustose taxa are compared in Table 1.

Tasmidella subfuscescens is known from Tasmania, Victoria and New Zealand. In Tasmania, it is extremely widespread and common in high rainfall areas, ranging from sea-level to alpine elevations. It occurs mostly on bark and wood, with a particularly favoured habitat being the trunks and branches of emergent small trees of *Banksia marginata* in buttongrass (*Gymnoschoenus*) moorland (Figure 2B), and the twigs and small branches of alpine shrubs. It also occurs on the dead leaves of *Richea pandanifolia* leaves in alpine woodland. These populations have a very smooth, effuse thallus and jet-black, marginate apothecia (Figure 2C), but accord with *T. subfuscescens* in all critical features. In Victoria, the species has been recorded from smooth-barked

understorey trees and shrubs in wet forest, whereas the New Zealand specimens studied are from the bark of small trees and shrubs at higher elevations.

Selected specimens examined: AUSTRALIA, TASMANIA:

Lake Esperance, 43°14'S 146°46'E, 980 m, 29.iii.1963, *P.W. James s.n.* (BM, HO); near Parrawe, 41°19'S 145°35'E, 420 m, 25.iv.1973, *G.C. Bratt 73/389* (HO); Platypus Tarn, 42°41'S 146°35'E, 1000 m, 13.iii.10980, *G. Kantvilas 20/80* (BM, HO); Mt Balfour, 41°17'S 144°53'E, 340 m, 17.xii.1983, *A. Moscal 4926* (HO); Mt Sprent, 42°47'S 145°59'E, 510 m, 17.ii.1987, *G. Kantvilas s.n.* (GZU, HO); Three Thumbs, 42°36'S 147°52'E, 480 m, 12.viii.1989, *G. Kantvilas 202/89* (HO); c. 1.5 km SSE of Platform Peak, 42°42'S 147°04'E, 670 m, 31.v.1990, *G. Kantvilas 294/90* (HO); Pelion Plains, 1 km W of Pelion Hut, 41°50'S 146°02'E, 890 m, 11.iii.1992, *G. Kantvilas 247/92* (GZU, HO); Sphinx Bluff, 41°37'S 147°44'E, 1370 m, 8.iv.1996, *G. Kantvilas 15/96* (HO); Downie Plains near Lake Augusta, 41°52'S 146°33'E, 1150 m, 10.vii.2005, *G. Kantvilas 171/05* (HO); Shipstern Bluff, 43°12'S 147°45'E, 80 m, 29.v.2011, *G. Kantvilas 181/11* (HO); Drip Beach, 43°13'S 147°04'E, 2 m, 3.iv.2018, *G. Kantvilas 28/18* (HO); Twisted Tarn, 42°39'S, 146°34'E, 1120 m, 8.iii.2021, *G. Kantvilas 72/21* (HO). **VICTORIA:** Bellel Creek, 5.x.1983, *G. Kantvilas s.n.* (HO); Errinundra Saddle, Rainforest Walk, 37°19'03"S 148°50'19"E, 910 m, 16.iv.2008, *G. Kantvilas 170/08 & J. Elix* (HO); Baw Baw NP, Mt Erica car park, 37°53'S 146°21'E, 1050 m, 13.iv.2008, *G. Kantvilas 187/08* (HO, MEL); Baw Baw NP, Mushroom Rocks,

Table 1. Comparison of some salient features of *Tasmidella* and some superficially similar genera.

	<i>Tasmidella</i>	<i>Megalaria</i>	<i>Lecidella</i>	<i>Ramboldia</i> (black-fruited species)	<i>Sarrameana</i>
thallus chemistry	atranorin or xanthonenes	nil, ± atranorin, ± zeorin, ± depsidones	commonly xanthonenes, ± atranorin, ± zeorin, ± depsidones	commonly depsides	atranorin (±)
major apothecial pigments	<i>cinereorufa</i> -green (N+ crimson)	<i>cinereorufa</i> -green (N+ crimson), <i>atrarad</i> , <i>hypnorum</i> -blue	<i>cinereorufa</i> -green (N+ crimson)	brown, K+ olive, N–	<i>cinereorufa</i> -green (N+ crimson)
apothecial exciple	annular, ± hyaline internally, interspersed with oil droplets; composed of radiating, prosenchymatous hyphae	cupulate, usually layered, internally hyaline or opaque, interspersed with oil droplets; composed of radiating, prosenchymatous hyphae	annular, internally hyaline or opaque, not interspersed, composed of ± radiating hyphae that become paraplectenchymatous at the outer edge	cupulate, ± hyaline internally, not interspersed; composed of radiating, prosenchymatous hyphae	cupulate, ± hyaline internally, interspersed with oil droplets; composed of radiating, prosenchymatous hyphae
ascus <i>masse axiale</i>	conical, penetrating the tholus completely	cylindrical and penetrating the tholus entirely (<i>M. grossa</i>) or conical, usually with an intensely amyloid edge	cylindrical, with a rounded apex, not penetrating the tholus entirely	cylindrical and penetrating the tholus entirely, often with diverging flanks	absent; tholus uniformly amyloid
ascospores	(0-)1-septate, ellipsoid, with a two-layered wall	1-septate, ellipsoid; wall single-layered	simple, ellipsoid; wall single-layered	simple, ellipsoid; wall single-layered	fusiform-acicular, simple or spuriously 3-7-septate; wall single-layered

37°53'S 146°21'E, 1200 m, 13.iv.2008, G. Kantvilas 144/08 (HO).

NEW ZEALAND: Canterbury, Craigieburn Range, Craigieburn Stream, 43°06'42"S 171°42'30"E, 1200 m, 27.xi.2010, G. Kantvilas 341/10 (HO).

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A revised generic circumscription of *Exocarpos* (Santalaceae), including the transfer of *Omphacomeria* to *Exocarpos*

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Introduction

Santalaceae (*sensu lato*, including Viscaceae) is a family of parasitic plants with 43 genera and c. 1115 species according to Plants Of the World Online (POWO, Govaerts *et al.* 2021, continuously updated). All genera currently recognized in POWO were included in a molecular phylogenetic study by Der and Nickrent (2008), with a few exceptions. They did not include the New Caledonian genus *Elaphanthera* N.Hallé (monotypic) that they considered a synonym of *Exocarpos* Labill., the south-east Asian *Henslowia* Blume (three species) that they considered a synonym of *Dendrotrophe* Miq., the Malesian *Hylomyza* Danser (three species) that they considered a synonym of *Dufrenoya* Chatin, or the southern African *Lacomucinaea* Nickrent & M.A.García (monotypic) that was later segregated from *Thesium* L. (Nickrent & García 2015).

In this study, the sampling of Santalaceae conducted by Der and Nickrent (2008) was expanded, particularly with regard to New Caledonian species, in order to clarify the relationship between *Elaphanthera* and *Exocarpos*. The monotypic genus *Elaphanthera* was established by Hallé (1988) to accommodate *Exocarpos baumannii* Stauffer (1959), a species restricted to the ultramafic substrates of the main island of New Caledonia. *Exocarpos* encompasses c. 27 species according to POWO,

Abstract

A molecular phylogenetic study was conducted to clarify the relationships between three genera of Santalaceae, the mostly Oceanic *Exocarpos* Labill., the Australian endemic and monotypic *Omphacomeria* (Endl.) A.DC., and the monotypic *Elaphanthera* N.Hallé, endemic to the main island of New Caledonia. *Omphacomeria acerba* (R.Br.) A.DC. was found to be nested in *Exocarpos*, while *Elaphanthera baumannii* (Stauffer) N.Hallé was sister to *Exocarpos*. Placement of *Elaphanthera* and *Omphacomeria* in an expanded *Exocarpos* is proposed on the basis of molecular data, supported by morphology. A new combination, *Exocarpos acerbus* (R.Br.) Lepschi, *comb. nov.*, is provided to accommodate *Omphacomeria acerba* in *Exocarpos*.

Keywords: Australia, New Caledonia, parasitic plants, taxonomy, ultramafic

occurring in south-east Asia, Malesia, Australia, and the Pacific Islands, extending to New Zealand, Hawai'i and French Polynesia. The monotypic Australian genus *Omphacomeria* (Endl.) A.DC. was also included in this analysis, in order to examine the relationship of this genus to *Exocarpos*, to which *Omphacomeria* is putatively closely related (Stauffer 1959; Nickrent *et al.* 2010). In two previous phylogenetic studies of the Santalaceae or Santalales, *Omphacomeria* has been retrieved as sister to *Exocarpos* (Der & Nickrent 2008) or even nested in this genus (Su *et al.* 2015). Stauffer (1959) considered that another genus, *Anthobolus* R.Br., was closely allied to *Exocarpos* and *Omphacomeria*. However the molecular phylogenetic analysis by Der & Nickrent (2008) recovered this genus within Opiliaceae. Kuijt & Hansen (2015) rejected this new placement and maintained *Anthobolus* in Santalaceae. Nevertheless, a later molecular study (Nickrent *et al.* 2019) based on a different accession of *Anthobolus* confirmed its placement within Opiliaceae and the genus is therefore not discussed further here.

Methods

Samples of *Elaphanthera baumannii* (Stauffer) N.Hallé, *Exocarpos neocalaedonicus* Schltr. & Pilg., *Exocarpos phyllanthoides* Endl., and *Exocarpos pseudocasuarina* Guillaumin were obtained from the field and from the Herbarium of New Caledonia (NOU, Bruy *et al.* 2023). Total genomic DNA was extracted from silica-dried leaves (Chase & Hills 1991) following a modified cetyltrimethylammonium bromide (CTAB) protocol (Doyle & Doyle 1987).

Nuclear small subunit (SSU) rDNA and two plastid genes were amplified: maturase K (*matK*) and ribulose-1,5-bisphosphate carboxylase/oxygenase large subunit (*rbcl*) with primers designed by Rogers *et al.* (2008). Purification and bidirectional sequencing were carried out by an external service (Genoscreen, Lille, France) on an automated sequencer using BigDye Terminator V3.1 reagents. The sequences were edited in MEGA X (Kumar *et al.* 2018). The dataset also included previously published accessions of *Exocarpos*, one representative of each genus of the *Santalum* clade (*sensu* Der & Nickrent 2008) to which *Exocarpos* belongs, as well as the genera *Leptomeria* R.Br., *Mida* R.Cunn. ex A.Cunn., *Nanodea* Banks ex C.F.Gaertn., and *Thesium* as further outgroups.

Sequences were aligned using MUSCLE (Edgar 2004) and cleaned from problematic alignment blocks using Gblocks 0.91 (Castresana 2000) using the less stringent options set.

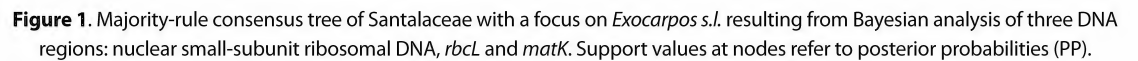
Phylogenetic analyses were conducted using Bayesian inference. The best substitution models for each DNA regions were determined using jModelTest version 2.1.6 (Darriba *et al.* 2012) and Akaike's information criterion (AIC). Then, these models were used in MrBayes v. 3.2.7 (Ronquist & Huelsenbeck 2003) linking the branch lengths but not the sampling of character-state frequencies, substitution rates, the gamma shape parameter and the proportion of invariant sites. Markov chain Monte Carlo (MCMC) analysis were performed for one million generations with eight chains, sampling every 1000th generation. Convergence of runs was assessed by examining the ESS of parameters under Tracer v.1.7 (Rambaut *et al.* 2018), using the recommended threshold of 200 (Drummond *et al.* 2006). A generated majority-rule consensus tree was generated after discarding a burn-in fraction of 25%. The tree was rooted with *Thesium*.

Results

A combined matrix of 22 terminals and 4,251 sites (with 14 % of gaps) was analysed. In our Bayesian phylogenetic analyses, convergence of runs is obtained with all parameters ESS values ≥ 200 . In the majority-rule consensus tree focused on *Exocarpos s.l.* (Figure 1) inferred from SSU rDNA, *matK* and *rbcl*, the genus *Exocarpos* was paraphyletic with the monotypic *Omphacomeria* nested in it, while *Elaphanthera baumannii* was recovered as sister taxon with strong support (PP=1).

Discussion

With our current sampling, *Elaphanthera baumannii* is retrieved as sister to the rest of the genus *Exocarpos*. Our results concur with the original placement of this species in *Exocarpos* by Stauffer (1959), and the conclusion of Der and Nickrent (2008) who treated *Elaphanthera* as a synonym of *Exocarpos*. *Elaphanthera* is also not included as an accepted taxon in the treatment of Santalaceae by Kuijt and Hansen (2015). *Elaphanthera* was defined by Hallé (1988) by the following morphological characters:



Omphacomeria is nested in the genus *Exocarpos* in our analysis, a result congruent with a previous study (Su et al. 2015) and ongoing phylogenomic investigations in the Santalales based on target sequence capture data for >300 loci (B.M. Anderson, pers. comm.). On the basis of these results and morphology, we propose placing

Omphacomeria has been distinguished from *Exocarpos* by the following morphological characters: plants unisexual (vs. mostly bisexual in *Exocarpos*, but see discussion below); ovary inferior (vs. superior, but see discussion below); and fruit sessile (vs. fruit borne

on a fleshy, greatly expanded receptacle). As with *Elaphanthera*, we consider that these characters serve to define a taxon (*Exocarpos acerbus*) at species rank, rather than supporting a distinction at the generic level.

Omphacomeria is dioecious, and while flowers in the Santalaceae are usually bisexual (Kuijt & Hansen 2015), sexual expression in the genus *Exocarpos* s.s. (excluding *Omphacomeria*), is diverse and frequently unclear, with bisexual, androdioecious, dioecious, and possibly also monoecious and gynodioecious systems occurring (Stauffer 1959). While dioecy is unusual among Australian Santalaceae and can aid in distinguishing *Omphacomeria* from other Australian members of the family, this sexual system has also been recorded in at least one Australian species of *Exocarpos*, *E. strictus* R.Br., as well as in *E. micranthus* Stauffer from New Guinea, and *E. phyllanthoides* Endl. from New Caledonia and Norfolk Island (Stauffer 1959). Accordingly, sexual system is not considered to be a useful distinguishing character to support recognition of *Omphacomeria* at generic rank.

Similarly, ovary position in *Omphacomeria*, described as inferior (de Candolle 1857; George 1984; Wiecek 1992; Jeanes 1999) or “practically inferior” (Smith & Smith 1943), is not clearly distinguishable as a morphological state from that observed in the genus *Exocarpos*, which appears transitional between truly inferior and superior states, and is therefore unreliable as a generic character. The ovary in *Exocarpos* is described as “semi-inferior” by Kuijt and Hansen (2015), and Smith and Smith (1943) describe the ovary in *Exocarpos* as “partly inferior though it appears to be essentially superior” and “not nearly as superior as it appears since the ventral carpellary strands arise deep in the fleshy receptacle that bears the ovary”.

The fruit in *Exocarpos* s.s. (excluding *Omphacomeria*) is borne on a brightly coloured, fleshy receptacle, and this character is absent in *Omphacomeria*. Fruits in *Exocarpos* s.s. are +/- hard when ripe, due to a comparatively thin mesocarp, and the exocarp is generally dark or dull coloured (dark green to purplish), often contrasting strongly with the receptacle colour. In *Omphacomeria*, the fruit is sessile, fleshy, with a thicker mesocarp and a dull green exocarp, frequently suffused purplish. The development of a brightly coloured, fleshy receptacle in *Exocarpos* s.s. is clearly related to fruit dispersal, predominantly by birds (Stauffer 1959; Barker & Vestjens 1989, 1990). Fruit dispersal vectors for *Omphacomeria*

(= *Exocarpos*) *acerba* are unknown, but the nature of the fruits also suggests bird dispersal, despite their relatively dull coloration. Birds (e.g. Emus, *Dromaius novaehollandiae*) are known to consume fruits of other species of Australian Santalaceae with dull, greenish fruits, such as *Choretrum pauciflorum* R.Br. (K.L.Brown, pers. comm.) and *E. sparteus* R.Br. (Stauffer 1959). The absence of a fleshy receptacle in *Omphacomeria* (= *Exocarpos*) *acerba* is unique in the genus *Exocarpos*, however this single character is not considered sufficient to warrant recognition at generic rank.

Taxonomy

Only names relevant to this study are presented below. For additional synonymy, see Stauffer (1959) and the Australian Plant Census (<https://biodiversity.org.au/nsl/services/search/taxonomy>; accessed 15 September 2023).

Exocarpos Labill., nom. cons., Voy. Rech. Pérouse 1: 155, t. 14 (1800)

Type: *Exocarpos cupressiformis* Labill.

= *Leptomeria* sect. *Omphacomeria* Endl., Gen. Pl. 236 (1837).

Omphacomeria (Endl.) A.DC., Prodr. [A. P. de Candolle] 14(2): 680 (1857), **syn. nov.**

Type (designated by Stauffer 1959): *Omphacomeria acerba* (R.Br.) A.DC.

= *Elaphanthera* N.Hallé, Fl. Nouv.-Calédonie & Dépend. 15: 134 (1988).

Type: *Elaphanthera baumannii* (Stauffer) N.Hallé.

Exocarpos acerbus (R.Br.) Lepschi, comb. nov.

Leptomeria acerba R.Br., Prodr. Fl. Nov. Holland. 354 (1810).

Omphacomeria acerba (R.Br.) A.DC., Prodr. [A. P. de Candolle] 14(2): 681 (1857).

Lectotype (designated by Stauffer 1959): **AUSTRALIA**, 1802, Brown 3202 (BM001010, islecto K, both n.v.).

<https://www.ipni.org/n/77327203-1>

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and advice on sequencing. One anonymous reviewer provided insightful comments on a previous version of the manuscript. The authors declare no conflicts of interest.

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Appendix

Genbank accession numbers for the three loci: nuclear small-subunit ribosomal DNA, *rbcL* and *matK*. Newly produced sequences are shown in bold.

Antidaphne viscoidea Poeppig & Endlicher, Costa Rica, S.Sargent *s.n.* (SIU), L24080, L26068, EF464500. *Colpoon compressum* Berg., South Africa, D.L.Nickrent, K.Steiner & A.Wolfe 4084 (SIU), EF584574, EF584590, EF584616. *Elaphanthera baumannii* (Stauffer) N.Hallé, New Caledonia, Y.Pillon *et al.* 1484 (NOU), **OR731824**, **OR594625**, **OR731824**. *Eubrachion ambiguum* (Hooker & Arnott) Engler, Puerto Rico, D.L.Nickrent, D.Clark & P.Clark 2699 (SIU), L24141, L26071, EF464498. *Exocarpos aphyllus* R.Br., Australia, A.Markey *s.n.* (SIU), EF584575, EF584593, EF584618. *Exocarpos bidwillii* Hook., New Zealand, B.Molloy *s.n.* (SIU), L24142, EF584594, EF584619. *Exocarpos latifolius* R.Br., Australia, A.Shapcott *s.n.* (BRI), —, KF496569, KM894916. *Exocarpos neocaledonicus* Schltr. & Pilg., New Caledonia, Y.Pillon *et al.* 1482 (NOU), 1482, —, **OR594626**, **OR594622**. *Exocarpos phyllanthoides* Endl., New Caledonia, Y.Pillon 1494 (NOU), **OR731825**, **OR594627**, **OR594623**. *Exocarpos pseudocasuarina* Guillaumin, New Caledonia, Y.Pillon *et al.* 1483 (NOU), **OR731826**, **OR594628**, **OR594624**.

Exocarpos sparteus R.Br., Australia, A.Markey *s.n.* (SIU), MH390518, MH390686, MH390644. *Lepidoceras chilense* (Molina) Kuijt, Chile, C.Martcorena & R.Rodríguez 10043 (CONC), EF464459, MH390687, MH390645. *Leptomeria aphylla* R.Br., Australia, B.J.Lepschi & A.J.Whalen 4875 (CANB), MH390526, MH390694, MH390651. *Mida salicifolia* A.Cunn., New Zealand, C.C. Ogle 3413 (CANB), EF584577, MH390691, MH390649. *Myoschilos oblongatum* Ruiz & Pavón, Argentina, R.Vidal-Russell *s.n.* (SIU), EF584578, MH390688, MH390646. *Nanodea muscosa* Banks ex C.F.Gaertn., Argentina, L. Collado *s.n.* 4893 (SIU), EF584579, MH390692, MH390650. *Nestronia umbellula* Raf., USA, L.J. Musselman *s.n.* (SIU), MH390521, MH390689, MH390647. *Omphacomeria acerba* (R.Br.) A.DC., Australia, B.J. Lepschi & B.R. Murray 4213 (CANB), EF584580, EF584602, EF584627. *Osyris alba* L., Spain, D.L.Nickrent, A.Aparicio & I.Sanchez García 4062 (SIU), —, LT599649, AM396499. *Rhoiacarpos capensis* A.DC., South Africa, D.L.Nickrent & G.Marx 4117 (SIU), EF584584, EF584606, EF584630. *Santalum album* L., India, R. Narayana *s.n.* (no voucher), L24416, —, —. *Santalum album* L., China, X.Liu *s.n.* (CAF), —, MW464922, MW464922. *Thesium fruticosum* A.W.Hill, South Africa, D.L.Nickrent & E.Brink 4115 (SIU), EF584587, EF584609, EF584633.

Australian cudweed key: An illustrated key to cudweed-like Gnaphalieae and related cushion plants of Australia, with notes on selected taxa

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Introduction

Australia is one of the diversity hotspots of Asteraceae tribe Gnaphalieae, and with approximately 510 of the 1,105 native species of Asteraceae, the Gnaphalieae are the most diverse tribe on the continent (A. Schmidt-Lebuhn, 2022). The diversity of Gnaphalieae in Australia includes button daisies with inconspicuous involucre bracts and everlasting paper daisies with colourful, radiating involucre bracts, and ranges in size from shrubs

and treelets to eight metres tall to tiny ephemeral herbs. Plants occur in diverse habitats including around salt lakes in the arid interior, coastal areas, and alpine areas. Within this tribe are also various species commonly called cudweeds.

‘Cudweed’ is a term describing a morphological appearance, generally woolly, small, herbaceous Gnaphalieae with somewhat unattractive, small, brownish capitula with neither conspicuously colourful,

Abstract

Cudweeds are generally herbaceous, woolly-haired members of Asteraceae tribe Gnaphalieae with small, brownish capitula. They constitute a polyphyletic group more or less congruent with an outdated, broad circumscription of the genus *Gnaphalium*. As a consequence of their small, inconspicuous capitula, high degree of morphological homoplasy, and type specimens that comprise mixtures of species, they are characterised by taxonomic confusion and generally considered difficult to identify. Existing identification keys are restricted either to individual Australian states or to genera and not or only sparsely illustrated. Descriptions frequently use obscure characters or terminology that do not lend themselves to efficient or non-destructive identification. Presented here is a comprehensive dichotomous key to all Australian native and introduced cudweeds (*Argyrotegium*, *Euchiton*, *Gamochaeta*, *Gnaphalium*, *Filago*, *Pseudognaphalium*, *Stuartina*) and their close relatives (e.g. *Ewartia*). It prioritises characters that are visible macroscopically or with a hand lens. Every species is illustrated with an image of a representative herbarium specimen, and key characters are illustrated with microscope images. The identity of selected species in *Euchiton*, *Gamochaeta*, and *Pseudognaphalium* treated in previously published keys is also discussed. Most important among them is *Pseudognaphalium lanatum*, a recently published name for a native Australasian species that has previously been subsumed under the cosmopolitan *P. luteoalbum*.

Keywords: taxonomy, cudweeds, Gnaphalieae.

radiating bracts nor ray florets. To the degree that the common name has a basis in scientific taxonomy, it is loosely congruent with the traditional, broad circumscription of *Gnaphalium* L., and thus ‘cudweeds’ are polyphyletic. As used in this paper, they include five disparate groups.

Most Australian cudweeds belong to the *Euchiton* clade in the Australasian clade of Gnaphalieae (Schmidt-Lebuhn & Bovill, 2021). It includes the cudweed-like genera *Euchiton* Cass., *Argyrotegium* J.M.Ward & Breitw., and *Stuartina* Sond., but also the entirely alpine taxa *Ewartia* Beauverd, *Helichrysum pumilum* Hook.f., and *Pterygopappus lawrencei* Hook.f. which, with the exception of one species, have white involucre bracts. The second group of cudweed species are members of *Gnaphalium* s.str., two of them native, one introduced to Australia. Third, the American genus *Gamochaeta* Wedd., of which several species have been introduced to Australia. Fourth are two introduced species of *Filago* L. from Europe. Both *Gamochaeta* and *Filago* are members of the FLAG clade of Gnaphalieae (Smissen et al., 2020). Finally, the Australian species of *Pseudognaphalium* Kirp., a member of the HAP clade of Gnaphalieae (Smissen et al., 2020), is also commonly called a cudweed.

Cudweeds are often described as difficult to identify (Verloove et al., 2023) and have complicated taxonomic histories (Drury, 1970; Flann, 2010a). Practical evidence for these difficulties is the large proportion of misidentified herbarium specimens and in some cases misidentified images illustrating online floras (pers. observ.). The difficulties arise perhaps partly because of the small, relatively drab capitula of cudweeds that require closer and more patient study to reveal identifying characters than the large, colourful capitula of other Gnaphalieae, and the high degree of homoplasy in the tribe.

However, the limitations of available identification keys for Australian cudweeds may also be part of the problem. Existing identification keys are generally geographically restricted. The most comprehensive ones are those in state floras, which accordingly cover only the respective states. The eFlora of Australia has not yet treated Gnaphalieae beyond a few selected genera. Taxonomic studies were also generally restricted to individual genera, thus not providing a comprehensive key to a group where end-users are likely to find it

difficult to decide what genus a specimen belongs to in the first place, and some authors did not include keys even when revising taxonomies or establishing new genera (Flann, 2010a; Ward et al., 2003).

Most existing keys are not or only sparsely illustrated. This is compounded by another issue, the frequent obscurity of characters used in the delimitation of genera and species. Diagnostic characters such as the number of filiform and tubular florets or the nature of papillae on the cypsela do not lend themselves to efficient identification in the field, to non-destructive identification in the herbarium, or to identification by end-users who are not Asteraceae taxonomists themselves.

This work presents a dichotomous key that, it is hoped, will fill this gap. It covers all native and introduced Australian cudweeds and related species. It prioritises the use of characters that are discoverable macroscopically or with a hand lens and which are reasonably easy to describe, especially growth form, leaf shape and dimensions, leaf indumentum, persistence of rosette leaves in flowering, inflorescence structure, and colour of involucre bracts. Every species is illustrated with an image of a representative herbarium specimen and, where necessary, the key refers to microscope images illustrating characters that are more obscure or difficult to describe.

Scope of the key

The scope of the key is Australian native and introduced cudweed-like plants as defined in the introduction and alpine, mat- or cushion-forming species of the *Euchiton* clade, as they are closely related to *Euchiton* and *Ewartia* and sometimes morphologically similar.

The following two species are excluded from the scope of the key. *Basedowia tenerima* (F.Muell.) J.M.Black is an annual endemic of the interior of South Australia. The author is insufficiently familiar with this species, and although it was placed in the *Euchiton* clade by nuclear data, it was placed outside by chloroplast data (A. N. Schmidt-Lebuhn & Bovill, 2021). More importantly, it is unlikely to be considered a cudweed because of its white involucre bracts, nor would it fall under the concept of related alpine mat-forming or cushion plants. *Facelis retusa* (Lam.) Sch.Bip. is a species introduced to Australia from South America characterised by crowded, narrowly

wedge-shaped leaves and inflorescences visually dominated by the developing pappi protruding from narrowly bottle-shaped, greenish capitula. Although it might be considered cudweed-like due to its small size and brownish-greenish appearance, its distinctive morphology otherwise puts it quite apart from the taxa covered in this key.

It should also be noted that there are other species not included in this key, as they are neither cudweeds nor closely related to them, but which could be confused with species covered by the key. For example, *Chthonocephalus pseudevax* Steetz is not included despite the possibility of confusion with *Filago pygmaea* L., as both are small rosetted plants with a sessile cluster of capitula.

Material and methods

The main sources of information consulted during development of the key are the Australian Plant Census (<https://biodiversity.org.au/nsi/services/search/taxonomy>), New South Wales FloraOnline hosted on PlantNet NSW (<https://plantnet.rbgsyd.nsw.gov.au/floraonline.htm>), a comprehensive key to the cudweeds of Queensland hosted on FloraBase (<https://keybase.rbq.vic.gov.au/keys/show/8361>), VicFlora (the online Flora of Victoria, <https://vicflora.rbq.vic.gov.au>), the Key to Tasmanian Vascular Plants hosted by the University of Tasmania (<https://www.utas.edu.au/dicotkey/dicotkey/key.htm>), and taxonomic studies of *Argyrotegium* (Walsh, 1999; Ward et al., 2003), *Euchiton* (Drury, 1972; Flann, 2010a, 2010b; Flann et al., 2008; Holub, 1974), *Gamochaeta* (Drury, 1971; Freire et al., 2021; Nesom, 2004; Urtubey et al., 2016; Verloove et al., 2023), and *Pseudognaphalium* (Smissen et al., 2022). Protologues of older species descriptions were consulted through the Biodiversity Heritage Library (<https://www.biodiversitylibrary.org>).

For the most part, examination of specimens was limited to those available at the Australian National Herbarium (CANB, including CBG) and the author's own experience with the group in the field. Specimen loans were not requested. In cases where the identity of species was in question, especially in *Euchiton* and *Gamochaeta*, images or drawings of type material were consulted. Images of type specimens were in most cases accessible through JSTOR Global Plants ([\[jstor.org\]\(https://plants.jstor.org\)\). In other cases, herbaria were contacted with image requests.](https://plants.</p>
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Macroscopic images in Figures 3–8 were cropped from photo libraries of herbarium specimens produced during systematic digitisation work at the Australian National Herbarium using an Aptus Leaf II 12, 80 megapixel camera with 72 mm Rolex lens and Schneider shutter controller. Microscope images in Figures 1–2, 5A, and 5C were taken with a Google Pixel 6 mobile phone mounted with an Apexel 200x microscope lens.

Notes on selected taxa

Taxonomic revision is beyond the scope of this paper, which for the most part follows the taxonomy currently accepted by the Australian Plant Census. However, as the purpose of the paper is to provide a means of identifying specimens to the correct names, a discussion of the correct application of some names, their types, and their treatment in previously published keys is unavoidable. Of particular concern is whether introduced species are named correctly, as taxonomic confusion can frustrate research on invasion biology or biological control of weeds (Pyšek et al., 2013).

Euchiton

The most comprehensive quantitative studies of *Euchiton* were conducted by Flann (2010a) and Flann et al. (2008). Flann demonstrated the identity of taxa shared between New Zealand and Australia and established the species delimitations that are currently accepted in Australia. Many species appear well defined, but *Euchiton japonicus* (Thunb.) Holub and its closest relatives remain problematic, as demonstrated by the many specimens Flann labelled as only “*Euchiton japonicus* complex”. This group of species is characterised by strongly discolourous leaves, with the adaxial side dark green and glabrous to sparsely hairy and the abaxial side densely white-hairy, and inflorescences of distinct terminal and axillary clusters of capitula on erect to ascending stems (Figure 7).

In Australia, the genus includes under currently accepted names *Euchiton japonicus*, *E. involucratus* (G.Forst.) Holub, *E. limosus* (D.G.Drury) Holub, and *E. sphaericus*. *Euchiton sphaericus* stands out as a non-stoloniferous annual with usually a single, terminal, hemispherical to more or less globular cluster of

capitula surrounded by a ring of leaves (Figure 7A). Some variation in the leaf shape from linear to obovate may suggest internal variation that could be formally recognised at some rank, but the species as currently circumscribed is seemingly well differentiated from the other three species, which are stoloniferous perennials with terminal and often a few axillary clusters of capitula.

Euchiton involucratus and *E. limosus* occur in wet habitats such as swamps, bogs, and grassy creekbanks. A key identifying character is the cypselas surface, which is glabrous in *E. limosus* but hairy in *E. involucratus* (Flann, 2010a). Since mature cypselas are not always available, these two species can be difficult to distinguish. 'Typical' specimens of *E. limosus* have leaves only to ca. 80 mm long (Figure 7C), and the species occurs in montane to alpine areas, whereas 'typical' specimens of *E. involucratus* have much longer leaves (Figure 7D), and the species occurs at lower elevations. However, leaf length and thus the overall appearance of specimens is variable, and it is possible that the two species grade into each other. A genetic study to test their differentiation, perhaps in combination with a common garden experiment, would be desirable to resolve this question.

Euchiton japonicus occurs in well-drained habitats such as patchy grassland or woodland and may be a minor weed in urban environments. Its key identifying character is that it retains a leaf rosette when flowering (Figure 7B), whereas the other species of the complex do not, and the leaves subtending its clusters of capitula rarely exceed the clusters' length. However, the species as currently circumscribed has a very large range from eastern Asia to New Zealand and includes great variation in the shape of both rosette- and cauline leaves. Rosette leaves may be more or less elliptical and ca. 2 cm long (*J.S. Whinray 1578*, CANB482138), or oblanceolate and ca. 10 cm long (*D.M. Cameron 3141*, CBG7803264). Cauline leaves may be extremely reduced (*J.S. Whinray 777*, CANB480741) or well developed, only slightly smaller versions of the rosette leaves, even towards the top of the scape (*C.L. Gunn s.n.*, CANB261592). In the latter case, the flowering parts of the plant approach *E. limosus* in appearance. Considering the likelihood or not of ongoing gene flow between populations, it may also seem doubtful if the populations native to Japan are conspecific to those native to Australia (although some entities may have been spread by humans).

To understand the degree of morphological similarity of Australian populations to those from the type location of *Euchiton japonicus* and what morphologies existing names would apply to, it was deemed prudent to consult, where possible, photographs or illustrations of the type of *Gnaphalium japonicum* Thunb., the basionym of *E. japonicus*, and of synonymised names relevant to Australia, *Gnaphalium gymnocephalum* DC. = *E. gymnocephalus* (DC.) Holub and *Gnaphalium collinum* Labill. = *E. collinus* Cass. The name *G. collinum* Labill. is illegitimate, and *Euchiton collinus* Cass. is a replacement name.

The drawing of the type of *Gnaphalium collinum* on Tab. 189 in Labillardiere's (1804) *Novae Hollandiae Plantarum Specimen* strongly resembles *Euchiton japonicum* as currently recognised in Australia. The rosette leaves are spreading, narrowly elliptic to oblanceolate, and short compared to the scapes. Cauline leaves are few and reduced. The scapes carry one terminal cluster of capitula subtended by a leaf at most slightly exceeding it and in one case a smaller axillary cluster.

The type of *Gnaphalium gymnocephalum* (G00469164) likewise matches *Euchiton japonicum* as currently recognised in Australia in inflorescence structure, with only a single terminal cluster of capitula subtended by leaves not exceeding it in length. The few rosette leaves are, however, much longer and narrower and more erect than those of the drawing of the type of *G. collinum*, in one case to 2/3–3/4 as long as the scapes.

The type of *Gnaphalium japonicum* (UPS-THUNB 19181) shows very long, narrow, seemingly erect rosette leaves at ca. 80–120 x 2–5 mm, scapes with few, strongly reduced cauline leaves, and 1–2 clusters of capitula per scape, with the larger terminal cluster ca. 15 mm in diameter. It is a much more robust plant than G00469164, albeit similar in leaf morphology. Should future work find Australian *Euchiton japonicus* to represent several species and/or a different species to the one occurring in eastern Asia, *E. collinus* therefore appears more likely to be resurrected than *E. gymnocephalus*.

As has been discussed by Drury (1972), the type material of *Gnaphalium involucratum* Forst.f. is a mixture of that species (e.g., GOET012699) and *Euchiton sphaericus* (e.g., FR0031015), which partly explains taxonomic confusion in the complex. Similarly, the Gaudichaud specimens labelled as type material of *Gnaphalium gymnocephalum*

at P (P00704714-P00704716) are a mixture of mostly *E. limosus* and two stems that may be *E. japonicus*.

Gamochaeta

The Australian Plant Census currently recognises six species of the American genus *Gamochaeta* Wedd. as introduced to the country: *G. americana* (Mill.) Wedd., *G. antillana* (Urb.) Anderb., *G. calviceps* (Fernald) Cabrera, *G. coarctata* (Willd.) Kerguelen, *G. pensylvanica* (Willd.) Cabrera, and *G. purpurea* (L.) Cabrera. While *G. pensylvanica* is easily recognised by its loosely woolly indumentum, capitula covered in woolly hairs, and relatively spaced-out capitulescence with well-developed subtending leaves, confusion persists about the differentiation between and status of *G. americana*, *G. coarctata*, and *G. purpurea*, as well as the differentiation between and status of *G. calviceps* and *G. antillana*.

According to available identification keys in Australia (e.g., PlantNet NSW, <https://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Gamochaeta>, and KeyBase, <https://keybase.rbg.vic.gov.au/keys/show/6334>, accessed 1 Sept 2023), *Gamochaeta coarctata* differs from *G. purpurea* and *G. americana* in the presence of a pale mid vein on the leaves and its capitulescence usually being a closed pseudospike versus pale midvein absent and capitulescence loose. *Gamochaeta purpurea* is then differentiated from *G. americana* by purple florets tips and basal leaves persistent at flowering and not stem-clasping versus floret tips yellow and basal leaves usually withered or withering at flowering and often stem-clasping.

Gamochaeta coarctata has recently been synonymised with *G. americana* (Freire et al., 2021). Introduced populations in the United States that had previously been treated under that name were subsequently described as *Gamochaeta impatiens* Nesom with the argument that the synonymisation of *G. coarctata* left them without a name (Nesom, 2022). Nesom did not mention *G. purpurea* but differentiated his new species from *G. americana* as follows:

Stems decumbent-ascending to nearly prostrate from the first; distal 1/3 of the lamina of the inner phyllaries rosy to light reddish-brown hyaline, the whole involucre often with a distinctly purplish or rosy cast; involucre 2.5–3 mm high; outer phyllaries depressed-ovate, apex rounded, inner with rounded apex; bisexual florets 2–3; corolla apices reddish; leaves glabrous and shiny adaxially, the basal persistent.
Gamochaeta impatiens

Stems first erect, sometimes becoming decumbent-ascending; distal half of the lamina of the inner phyllaries brown and sharply delimited in colour from the proximal portion, the whole involucre often with a distinctly brownish cast; involucre 3–4 mm high; outer phyllaries ovate to oblong-lanceolate, apex mostly acute or acuminate, inner with acute apex; bisexual florets (2–)3–7; corolla apices yellow; leaves usually glabrescent adaxially, sometimes becoming shiny, the basal often not persistent.
Gamochaeta americana

Nesom (2022) stated that *Gamochaeta impatiens* has been introduced at least to Swaziland and New Zealand and recommended the identity of introduced populations in other countries currently treated as *G. americana* or *G. coarctata* be re-examined. Fresh, flowering specimens of what appeared to be two different species growing in Canberra, ACT, were therefore sampled and photographed to ensure that floret colours could be examined.

The first had rosette leaves withered at flowering, adaxial leaf sides finely hairy and light green, stems erect from a quickly ascending base, involucre ca. 4 mm long, phyllary tips brown when young, outer phyllaries ovate and apically attenuate, and (2–)4(–5) bisexual florets with purple tips. It matches the concept of *Gamochaeta purpurea* in the Flora of North America (http://efloras.org/florataxon.aspx?flora_id=1&taxon_id=242416575, accessed 31 Oct 2023), except that the flora description also allows for purple phyllary tips in bud.

The second had rosette leaves persistent at flowering, adaxial leaf sides finely hairy and dark green, stems at first procumbent, then ascending, involucre ca. 3.5 mm long, phyllary tips purple when young, outer phyllaries ovate and apically obtuse, and 2–3 bisexual florets with purple tips. Despite failing to conform to Nesom's (2022) couplet cited above in adaxial leaf indumentum and length of the involucre, it is a close match to all photos illustrating his concept of *Gamochaeta impatiens* (Nesom 2022, Figures 11–19).

Nesom's (2022) concept of *Gamochaeta americana* matches that underlying previously published Australian keys in floret colour but not in leaf shape. Since floret colour is lost in drying, leaf shape and involucre bract shapes are similar, and the number of bisexual florets is overlapping, *G. americana* and *G. purpurea* may be difficult to differentiate as herbarium specimens. However, differentiation of living plants at the flowering stage is easy because of the conspicuous colouration

of *G. americana*, with involucre bracts basally green, apically dark brown, and strongly contrasted with the yellow floret tips (Nesom 2022, Figures 4–10; see also iNaturalist record 101802520 from Victoria for an Australian example), whereas *G. purpurea* has light brown and greenish involucre bracts and less conspicuous, dark purple florets.

Although the taxonomic concepts of Nesom (2022) and the Flora of North America therefore match three entities occurring in Australia, the correct application of names to the concepts may be more doubtful. The type of *Gnaphalium purpureum* (LINN 989.73) is only a single, seemingly young flowering stem without a rosette, although that may simply not have been collected. The lectotype of *Gnaphalium americanum* Mill. (BM001009488) had a lush rosette at flowering, and the basal leaves have broad bases, both characters more reminiscent of *Gamochaeta impatiens*. Given the number of names published in *Gamochaeta*, and the fact that *G. impatiens* was described from its introduced range, it also remains possible that the species may have an older name in its area of origin. Only a comprehensive revision of the genus across South and Central America can provide certainty in this regard.

Most Australian identification keys do not include *Gamochaeta antillana*, and one that does, on PlantNet NSW, appears to have paraphrased information from the couplet published by Nesom (2004) that differentiates this species and *G. calviceps* as follows:

Involucres 3–3.5 mm, lightly arachnose only at the base or not at all; capitulescence interrupted at least distally, main axis visible to terminal heads; phyllaries in 5–7 series, outer and middle ovate-triangular with sharply acute-acuminate apices, 1/3–1/2 as long as the inner, none with purplish colour; flowering May–Jul.

Gamochaeta calviceps

Involucres 2.5–3 mm, seated in tomentum; capitulescence initially cylindric and uninterrupted, at least distally, main axis obscured by clustered heads; phyllaries in 3–4(–5) series, outer and middle ovate-lanceolate with narrowly to broadly acute apices, outer 1/2–2/3 as long as inner, at least innermost commonly tinged with purple at stereome-lamina junction; flowering (Feb–)Mar–May, sometimes later with moisture.

Gamochaeta antillana

It was difficult to discern an arrangement of the involucre bracts into series in any of the material examined as part of this work. There are, however, two groups of specimens of *Gamochaeta* with concolourous leaves in CANB. The first is characterised by inflorescences of dense pseudospikes mostly without protruding

subtending leaves except at the very base or when young (cf. *G. antillana* fide Nesom), involucre yellowish-brownish, senescing to brown (cf. *G. calviceps*), and outer involucre bracts triangular (cf. *G. antillana*) but short (cf. *G. calviceps*) (Figures 1G, 6D). These specimens match the type material of *Gnaphalium antillanum* (N.L. Britton 9619, NY00126654, and N.L. Britton 10009, NY00126655, the latter chosen as the lectotype by Nesom).

The second group is characterised by inflorescences with clusters of capitula more distant from each other, often leafy, and often branched (cf. *Gamochaeta calviceps* fide Nesom), involucre purple when in bud and beginning to flower and senescing to brown (cf. *G. antillana*), and outer involucre bracts narrowly acute (cf. *G. calviceps*) but long (cf. *G. antillana*) (Figure 1F, 6E). These specimens match the type of *G. calviceps* (M.L. Fernald 4245, GH) at least in inflorescence structure, with the caveat that there is uncertainty in interpreting the shape of the outer involucre bracts from viewing the specimen image alone.

It is possible that Nesom (2004) accidentally swapped involucre bract colours and outer bract apex shapes to the wrong leads in his couplet, and authors of Australian keys have copied the mistake.

Urtubey et al. (2016) listed differences primarily in plant height and leaf shape (15–25 cm tall, lower cauline leaves linear to lanceolate for *Gamochaeta antillana*, 20–40 cm tall, lower cauline leaves linear-oblongate for *G. calviceps*). Specimens at CANB suggest that the yellowish-brown, pseudo-spicate plants tend to remain shorter than the purplish, paniculate ones. But as these species are annuals, which can be very diminutive under poor conditions, and the type material of *G. antillana* is very robust, plant height may not be a reliable character. On the other hand, the difference in lower cauline leaves described by Urtubey et al. (2016) is reflected in the type specimens, with those of *G. antillana* more or less linear or only slightly oblongate and those of *G. calviceps* distinctly oblongate.

Taxonomic uncertainty about introduced species is a global phenomenon, and a recent paper discussed the identity of *Gamochaeta* species naturalised in Belgium and the Netherlands (Verloove et al., 2023). The well-illustrated study assigned specimens visually matching Australian concolourous-leafed, purple-capitulate *Gamochaeta* to *G. subfalcata* (Cabrera) Cabrera,

and indeed the type of *G. subfalcata* (A.L. Cabrera 944, LP000244) also matches the purple-capitulate *Gamochaeta* of Australia. However, Verloove & al. (2023) discussed only the potential synonymy of *G. subfalcata* with *G. antillana* but did not consider the name *G. calviceps* as an option. If *G. calviceps* and *G. subfalcata* are synonyms, the former name has priority. Similarly, the eFlora of New Zealand recognises concolourous-leaved, purple-capitulate *Gamochaeta* as *G. subfalcata* (<https://www.nzpcn.org.nz/flora/species/gamochaeta-subfalcata/>, accessed 7 Sep 2023). It is considered likely that these plants introduced to Europe, Australia, and New Zealand are all conspecific.

For the key in this paper, the following decisions were made regarding *Gamochaeta*: (1) To follow Nesom's (2022) concepts for *G. americana* and *G. impatiens* and to differentiate *G. purpurea* from both based on the combination of purple florets, light brown involucre bracts, and outer involucre bracts acute to attenuate. The relevant section of the key therefore differs significantly from how these three species were conceptualised in previously published Australian keys. (2) To align the identity of *G. antillana* and *G. calviceps* with the morphology of their types instead of with Nesom's (2004) couplet. And (3) to refer concolourous-leaved, purple-headed *Gamochaeta* to *G. calviceps* instead of *G. subfalcata* as suggested by Verloove & al. (2023) for Europe and by the eFlora of New Zealand. However, only a dedicated study comparing the application of names in areas where *Gamochaeta* has been introduced with that in the American areas of origin and carefully examining type specimens would be able to resolve the existing taxonomic confusion.

Pseudognaphalium

Both the Australian Plant Census and Australian herbaria currently recognise Australian specimens of *Pseudognaphalium* as *P. luteoalbum* (L.) Hilliard & B.L.Burt, a near-cosmopolitan weed. A recent study has shown *Pseudognaphalium* of New Zealand to be two distinct species, presumably introduced *P. luteoalbum* with usually red florets and colourless involucre bracts at anthesis and more sparsely woolly indumentum, and the native Australasian species *P. lanatum* (G.Forst) Smitsen, Breitw. & de Lange with yellow florets and yellowish to brownish involucre bracts at anthesis

and more densely woolly indumentum (Smitsen et al., 2022). This raises the question if both species also occur in Australia.

Floret colour is unavailable or sometimes misleading on dried herbarium specimens, as the florets lose colour or may turn purplish. It also appears that the character is not reliable, i.e., that plants of *Pseudognaphalium luteoalbum* can have red or yellow florets (Rob Smitsen, pers. comm.). Smitsen et al. (2022) further remarked that the density of the indumentum, while distinctive where the two species grow together, is influenced by environmental conditions and therefore not a reliable differentiator for plants examined in isolation. This means that the most promising character for the identification of herbarium specimens would be the colour of involucre bracts of capitula that had been flowering when collected (Figure 1H–I), but identification of some specimens will be difficult, as the bracts senesce to brown.

Most of the Australian specimens of *Pseudognaphalium* at CANB from Western Australia, Northern Territory, South Australia, and Tasmania appear very characteristic of *P. lanatum*, with a distinctive contrast between white-woolly stem and leaves and golden-brownish capitula (Figure 8A). Specimens from the eastern half of the Australian mainland are morphologically more diverse. Plant from the urban area of Canberra that were easily accessible to me as fresh material have colourless involucre bracts and represent *P. luteoalbum*, albeit with yellow florets (Figure 8B).

Examination of 1,042 Australian records identified as *Pseudognaphalium* on iNaturalist (inaturalist.org, accessed 31 Oct 2023) revealed one record from Victoria matching Smitsen et al.'s (2022) description of *P. luteoalbum* in all aspects including the reddish florets (134380257), and its identity was subsequently confirmed by Rob Smitsen. In summary, this suggests that both *P. luteoalbum* and *P. lanatum* occur in Australia. Further study would be desirable to increase our understanding of their ranges.

Key to the species

Asterisks indicate species introduced to Australia.

- 1 Capitula solitary 2
- 1: Inflorescences of several to many capitula 12
- 2 (1) Leaves narrowly linear; coastal *Euchiton litticola* A.M.Buchanan (Figure 4A)
- 2: Leaves obovate to oblanceolate; montane to alpine 3
- 3 (2) Leaves +/- appressed onto stem, strongly overlapping, the visible part of the lamina only up to about as long as wide (Figure 2A) *Pterygopappus lawrencei* Hook.f. (Figure 3A)
- 3: Leaves variously spreading, the visible part of the lamina longer than wide 4
- 4 (3) Involucre with white, spreading tips 5
- 4: Involucre brown, not spreading when in flower 8
- 5 (4) Capitula on robust, woolly, leafy scapes ca. 2-6 cm tall when in flower *Helichrysum pumilum* Hook.f. (Figure 4B)
- 5: Capitula sessile in flower but often with elongating, weak scapes ca. 1-2 cm tall in fruit 6
- 6 (5) Leaves ca. 2.5-5.0 mm wide, apex obtuse-apiculate *Ewartia catipes* (DC.) Beauverd (Figure 3B)
- 6: Leaves ca. 1.5-3.0 mm wide, apex acute 7
- 7 (6) Leaves when fresh characteristically yellowish to white on margins and abaxial surface, greenish on adaxial surface; Tasmania ... *Ewartia meredithae* (F.Muell.) Beauverd (Figure 3C)
- 7: Leaves grey-hairy on both surfaces; mainland Australia *Ewartia nubigena* (F.Muell.) Beauverd (Figure 3D)
- 8 (4) Capitula on +/- robust, leafy shoots even when in flower; leaves ca. 10-30 mm long 9
- 8: Capitula sessile in flower but generally with elongating, weak scapes in fruit; leaves up to ca. 15 mm long 10
- 9 (8) Rosette leaves narrowly oblanceolate, base narrowly attenuate, green above and greyish-green below; flowering stalks ascending laterally from rosette; Tasmania *Euchiton lateralis* (C.J.Webb) Breitw. & J.M.Ward (Figure 4C)
- 9: Rosette leaves oblanceolate, base cuneate, +/- equally grey on both sides; flowering stalk ascending from middle of rosette; mainland Australia or Tasmania *Euchiton traversii* (Hook.f.) Holub (Figure 4D)
- 10 (8) Leaf apex with incurved mucro (Figure 2B) *Ewartia planchonii* (Hook.f.) Beauverd (Figure 3E)
- 10: Leaf apex without mucro, or mucro not incurved 11
- 11 (10) Leaves compactly woolly with appressed hairs (Figure 2C), 5-7 mm long, only slightly narrowing towards wedge-shaped base *Argyrotegium nitidulum* (Hook.f.) J.M.Ward & Breitw. (Figure 3F)
- 11: Leaves softly woolly with loose hairs (Figure 2D), 6-12(-15) mm long, base attenuate *Argyrotegium mackayi* (Buchanan) J.M.Ward & Breitw. (Figure 4E)
- 12 (1) Apices of involucre bracts recurved into hardened hooks 13
- 12: Apices of involucre bracts straight, papery to membranous 14
- 13 (12) Apices of involucre bracts yellow, ca. 1-2 mm long (Figure 5A) *Stuartina hamata* Philipson (Figure 5B)
- 13: Apices of involucre bracts reddish-brownish, ca. 1(-1.5) mm long (Figure 5C) *Stuartina muelleri* Sond. (Figure 5D)
- 14 (12) Inflorescences at ground level, sessile clusters of capitula surrounded by solitary or clustered rosettes of leaves **Filago pygmaea* L. (Figure 5E)
- 14: Inflorescences on erect or ascending stems 15
- 15 (14) Capitula in a narrowly pyramidal panicle or pseudospike (Figure 6) 16
- 15: Capitula either in terminal clusters or in terminal and axillary clusters clearly separated from each other, not pyramidal (Figures 7-8) 22
- 16 (15) Adaxial leaf surfaces glabrous or sparsely hairy and dark green, abaxial surfaces densely white-hairy 17
- 16: Leaves distinctly greyish- to white-hairy on both sides 20
- 17 (16) Capitula partly obscured by woolly hairs; leaves loosely woolly-hairy. **Gamochaeta pensylvanica* (Willd.) Cabrera (Figure 6B)
- 17: Peduncles woolly-hairy, but capitula freely visible; leaves with fine, appressed hairs on abaxial surface 18
- 18 (17) Rosette and lower stem leaves usually present at flowering, with wide base clasping around the stem; flowering stems ascending from a procumbent base; tips of outer involucre bracts obtuse (Figure 1B) .. **Gamochaeta impatiens* Nesom (Figure 6F)
- 18: Rosette and lower stem leaves often withered or withering at flowering, with narrowed, petiole-like base; flowering stems usually erect; tips of outer involucre bracts acute to attenuate 19
- 19 (18) Involucre bracts apically light brown at flowering, the outer and middle ones sharply attenuate (Figure 1C); tips of florets purple; bisexual florets (2-)3-4(-5) **Gamochaeta purpurea* (L.) Cabrera (Figure 6G)
- 19: Involucre bracts apically dark brown at flowering, the outer and middle ones acute (Figure 1D); tips of florets yellow; bisexual florets (2-)3-7 **Gamochaeta americana* (Mill.) Wedd. (Figure 6C)

- 20 (16) Involucral bracts with callus-like green stereome and broad, membranous, often dark brown apex (Figure 1E); indumentum loosely woolly; stems weak; florets yellow..... ***Gnaphalium polycaulon** Pers. (Figure 6A)
- 20: Involucral bracts sometimes greenish towards base but with inconspicuous stereome and firm to the apex, light brown or purplish (Figure 1F–G); indumentum appressed; stems robust; florets purplish 20
- 21 (20) Involucres yellowish-brownish (Figure 1F); inflorescence a dense pseudospike; generally on sandy soils ***Gamochaeta antillana** (Urb.) Anderb. (Figure 6E)
- 21: Involucres purplish in bud and early flowering (Figure 1G) but turning brown in fruit; inflorescence of +/- distinct clusters of capitula when mature, often basally branched; on various substrates ***Gamochaeta calviceps** (Fernald) Cabrera (Figure 6D)
- 22 (15) Side branches overtopping the terminal clusters ***Filago pyramidata** L. (Figure 5F)
- 22: Side branches absent or shorter than continuation of main branch..... 23
- 23 (22) Adaxial leaf surfaces glabrous or sparsely hairy and dark green, abaxial surfaces densely white-hairy..... 24
- 23: Leaves distinctly grey- or white-hairy on both surfaces 27
- 24 (23) Erect annuals; capitula usually in a single, subglobular to hemispherical terminal cluster subtended by several leafy bracts forming a kind of secondary involucre
Euchiton sphaericus (Willd.) Holub (Figure 7A)
- 24: Stoloniferous perennials; capitula often in several clusters, generally a large terminal cluster and one or a few smaller clusters in the axils of the upper leaves, subtended by only one to few leafy bracts..... 25
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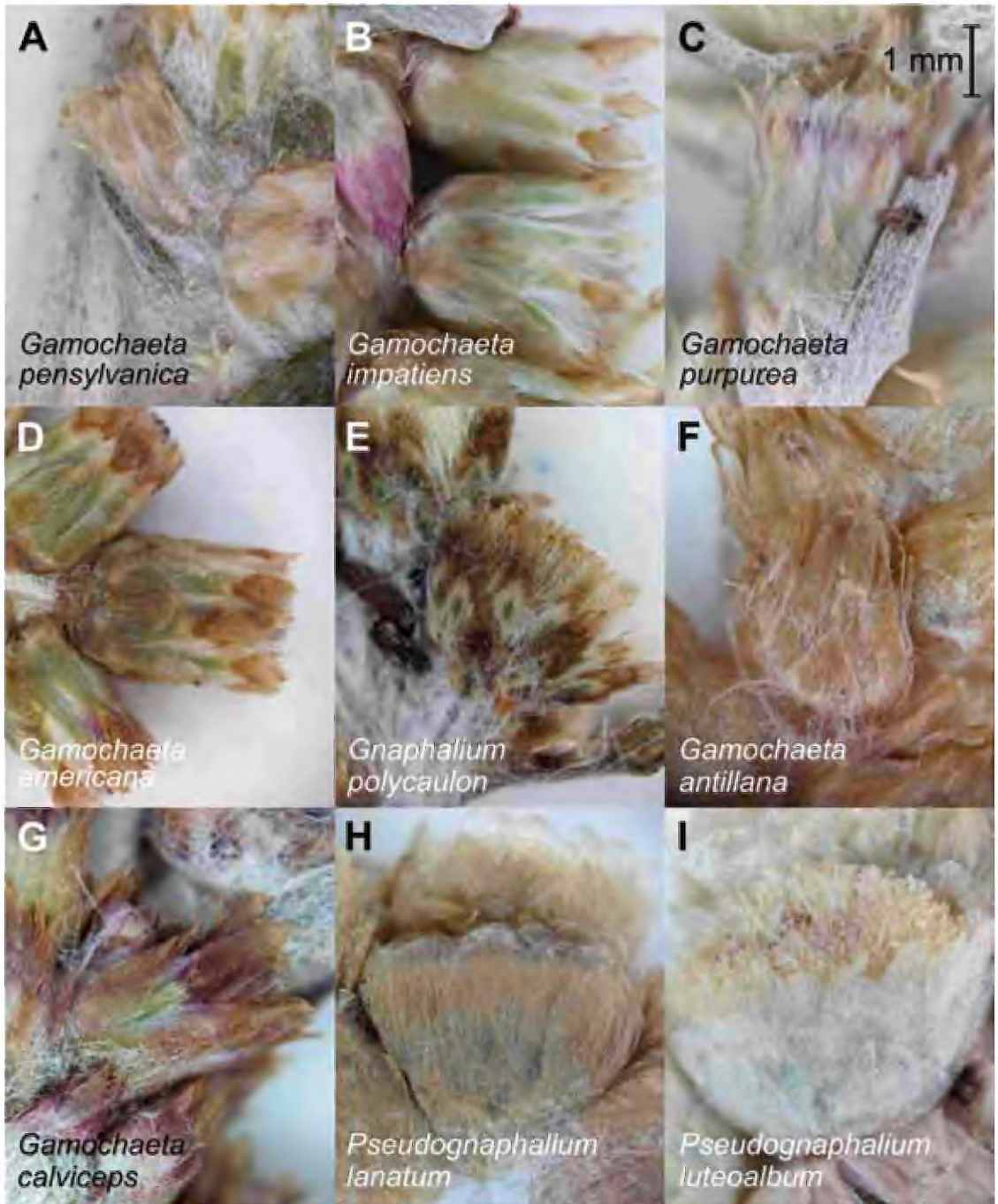


Figure 1. Capitula of selected species of cudweeds. A. *Gamochaeta pensylvanica* (M. Gray 5210, CANB345111). B. *Gamochaeta impatiens* (B.J. Lepschi 664, CANB420076). C. *Gamochaeta purpurea* (R.W. Purdie 9200, CANB869445). D. *Gamochaeta americana* (D.M. Cameron 939, CBG7803269). E. *Gnaphalium polycaulon* (E. Chesterfield 2551, CANB400540). F. *Gamochaeta antillana* (C.W.E. Moore 9263A, CANB449516). G. *Gamochaeta calviceps* (L.G. Adams 3424, CANB381845). H. *Pseudognaphalium lanatum* (A.N. Schmidt-Lebuhn 1516, CANB813011). I. *Pseudognaphalium luteoalbum* (D.E. Albrecht 15432, CANB909690). All images are to the same scale.

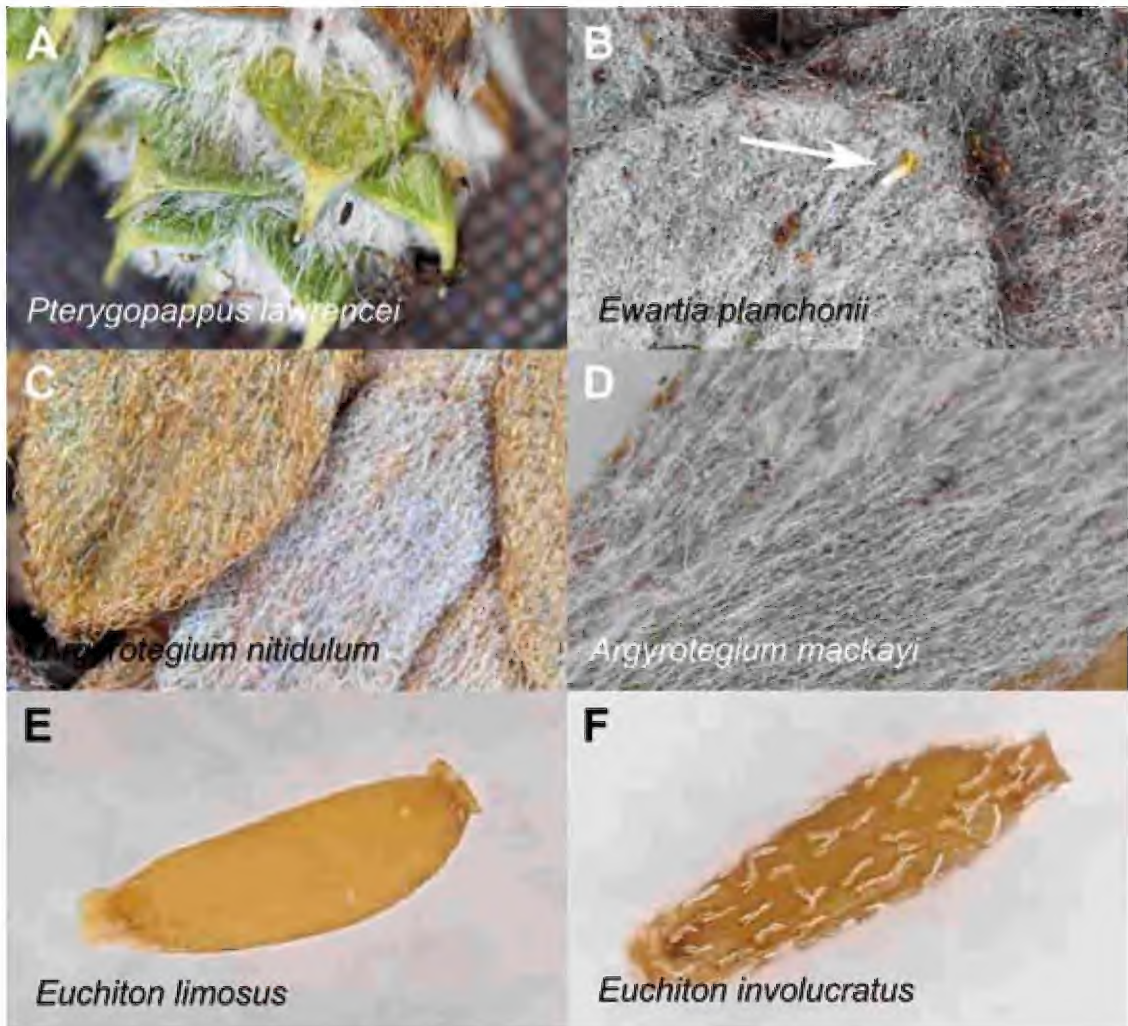


Figure 2. A. Leaves of *Pterygopappus lawrencei* (A.N. Schmidt-Lebuhn 2061, CANB). B. Incurved mucro at leaf apex of *Ewartia planchonii* (arrow) (A.N. Schmidt-Lebuhn 2040, CANB). C. Appressed leaf indumentum of *Argyrotegium nitidulum* (M. Gray 6609, CANB366615). D. Loose woolly leaf indumentum of *Argyrotegium mackayi* (P.A. Keane 23, CANB344252). E. Cypsel of *Euchiton limosus* (N.T. Burbidge 7561, CBG177139). F. Cypsel of *Euchiton involucratus* (L.G. Adams 3979, CANB376797).

Images were not calibrated.

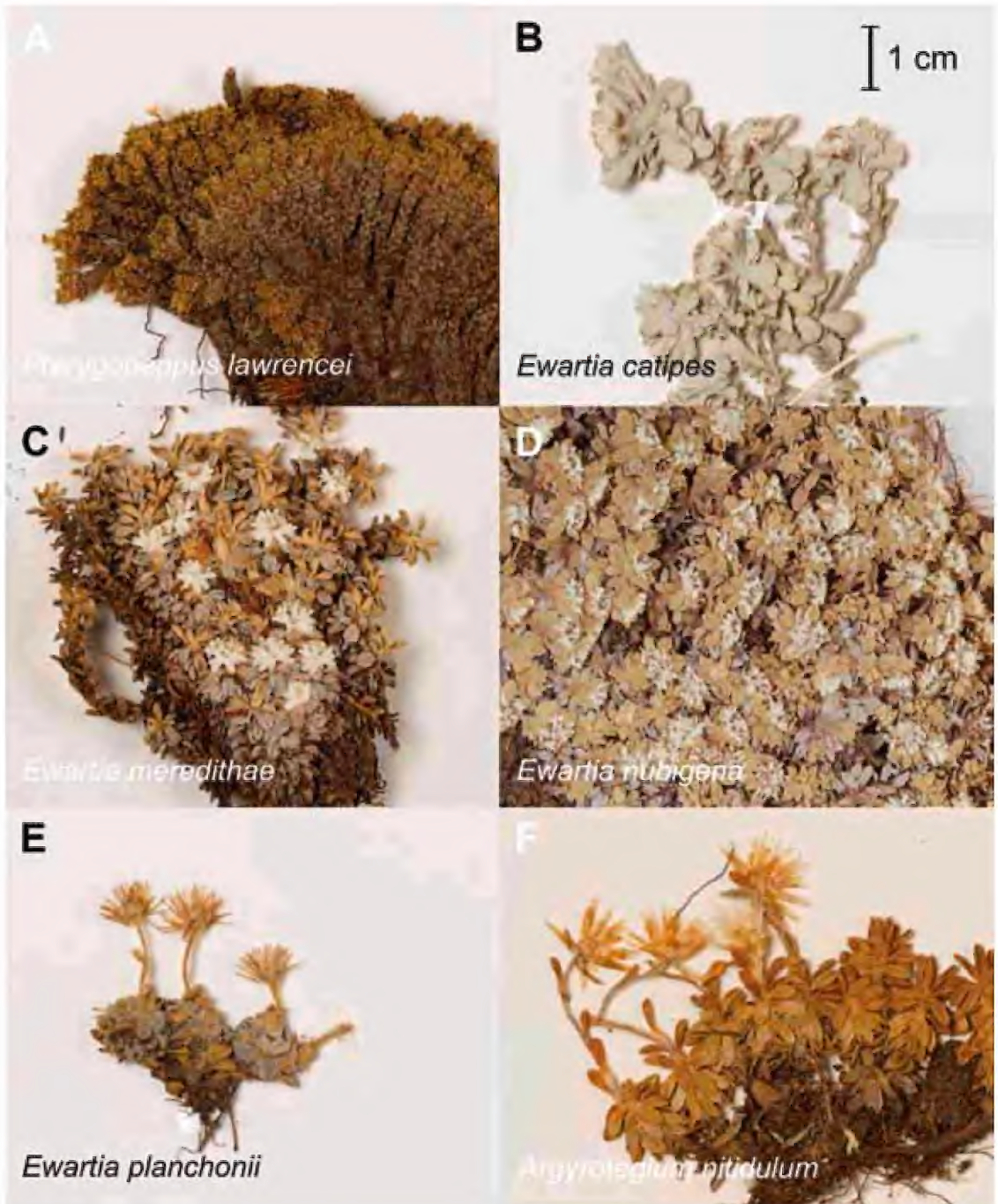


Figure 3. Small, mostly mat- or cushion-forming species with solitary capitula. A. *Pterygopappus lawrencei* (I.R. Telford 2218, CBG26614). B. *Ewartia catipes* (J. Wood 329, CANB818796). C. *Ewartia meredithae* (I.R. Telford 2215, CBG27596). D. *Ewartia nubigena* (E. Gauba s.n., CBG12850). E. *Ewartia planchonii* (T. Shimizu 3915, CANB508103). F. *Argyrolegium nitidulum* (M. Gray 6609, CANB366615). All images are to the same scale.

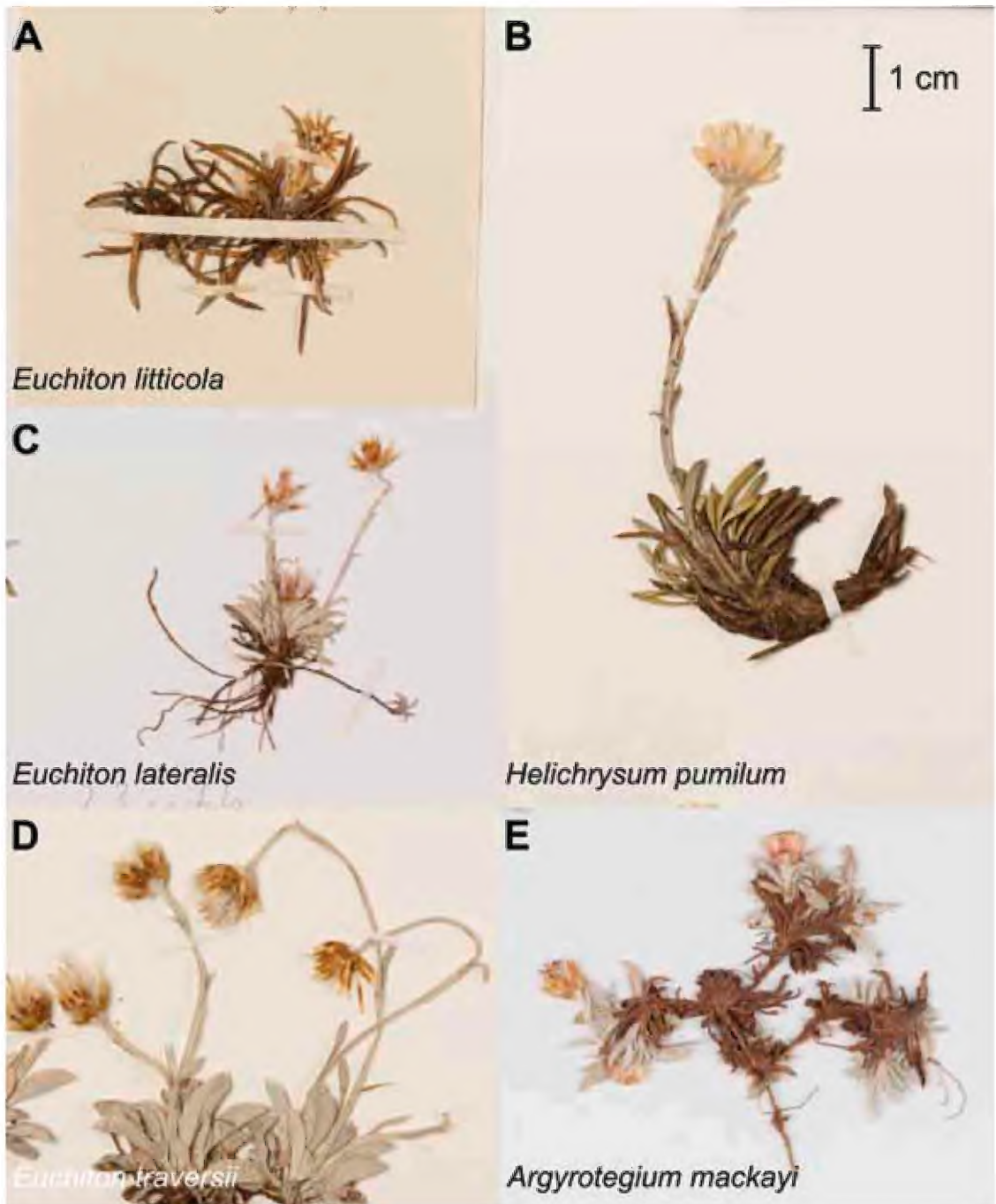


Figure 4. Larger species with solitary flowerheads. A. *Euphorbia litticola* (J.H. Willis s.n., CANB177044). B. *Euphorbia pumilum* (B. Barnsley 1248, CBG8001095). C. *Euphorbia lateralis* (B. Barnsley 1218, CBG8001065). D. *Euphorbia traversii* (P. Gilmour 6341, CBG8802311). E. *Euphorbia mackayi* (D.N. McVean s.n., CANB344257). All images are to the same scale.

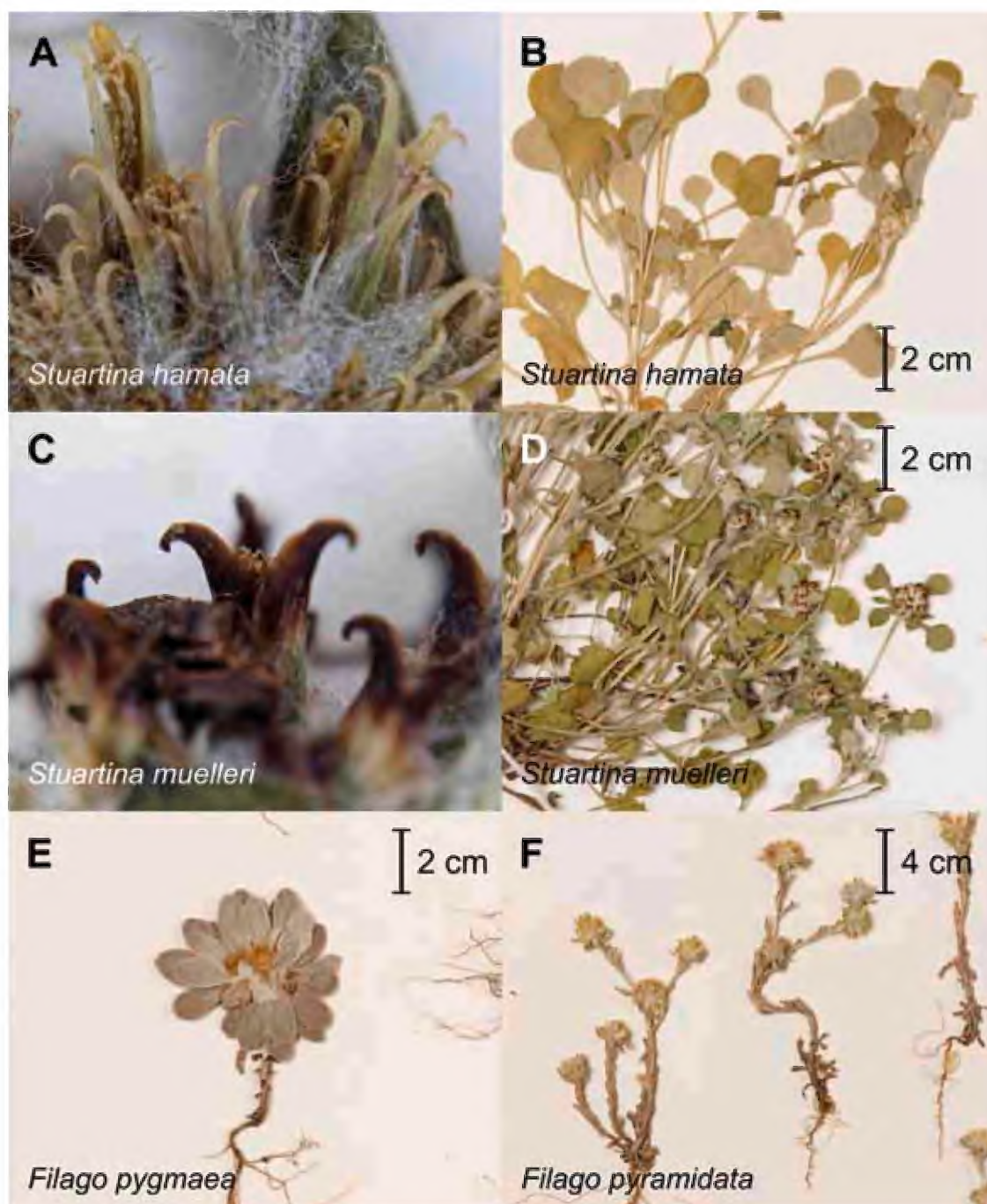


Figure 5. *Filago* and *Stuartina*. A-B. *Stuartina hamata*, with A showing apices of involucre bracts (A. Slee 726, CANB382198). C-D. *Stuartina muelleri*, with C showing apices of involucre bracts (A.N. Schmidt-Lebuhn 1107, CANB795970). E. *Filago pygmaea* (J. Stefani s.n., CANB346441). F. *Filago pyramidata* (B. Copley 2386, CANB346495). Images have individual scale bars except for A and C, which were not calibrated.

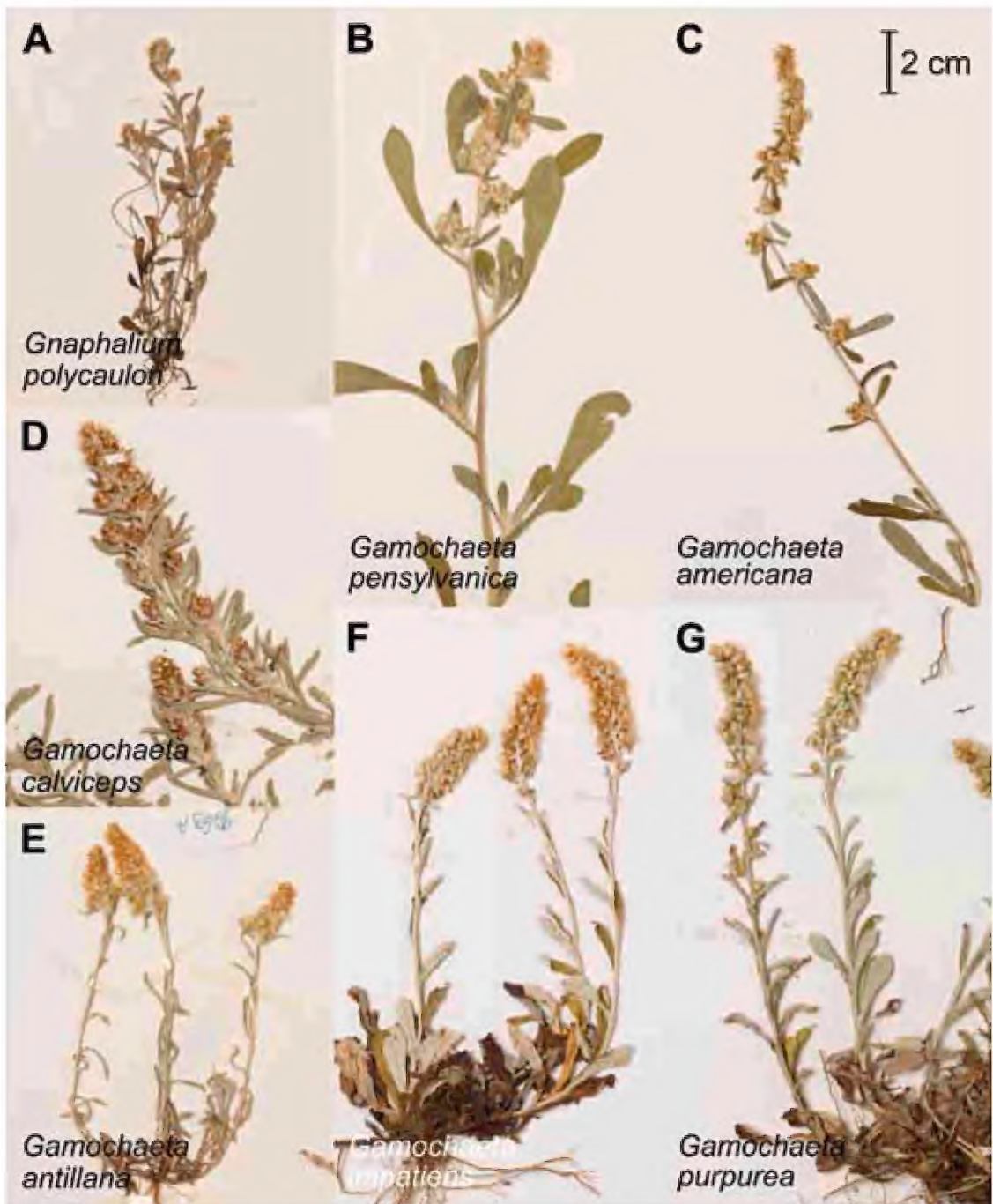


Figure 6. Species with flowerheads in narrowly pyramidal panicles or pseudospikes. A. *Gnaphalium polycaulon* (E. Chesterfield 2551, CANB400540). B. *Gamochaeta pensylvanica* (M. Gray 5210, CANB345111). C. *Gamochaeta americana* (D.M. Cameron 939, CBG7803269). D. *Gamochaeta calviceps* (L.G. Adams 3424, CANB381845). E. *Gamochaeta antillana* (C.W.E. Moore 9263A, CANB449516). F. *Gamochaeta impatiens* (B.J. Lepski 664, CANB420076). G. *Gamochaeta purpurea* (R.W. Purdie 9200, CANB869445). All specimens are to the same scale.

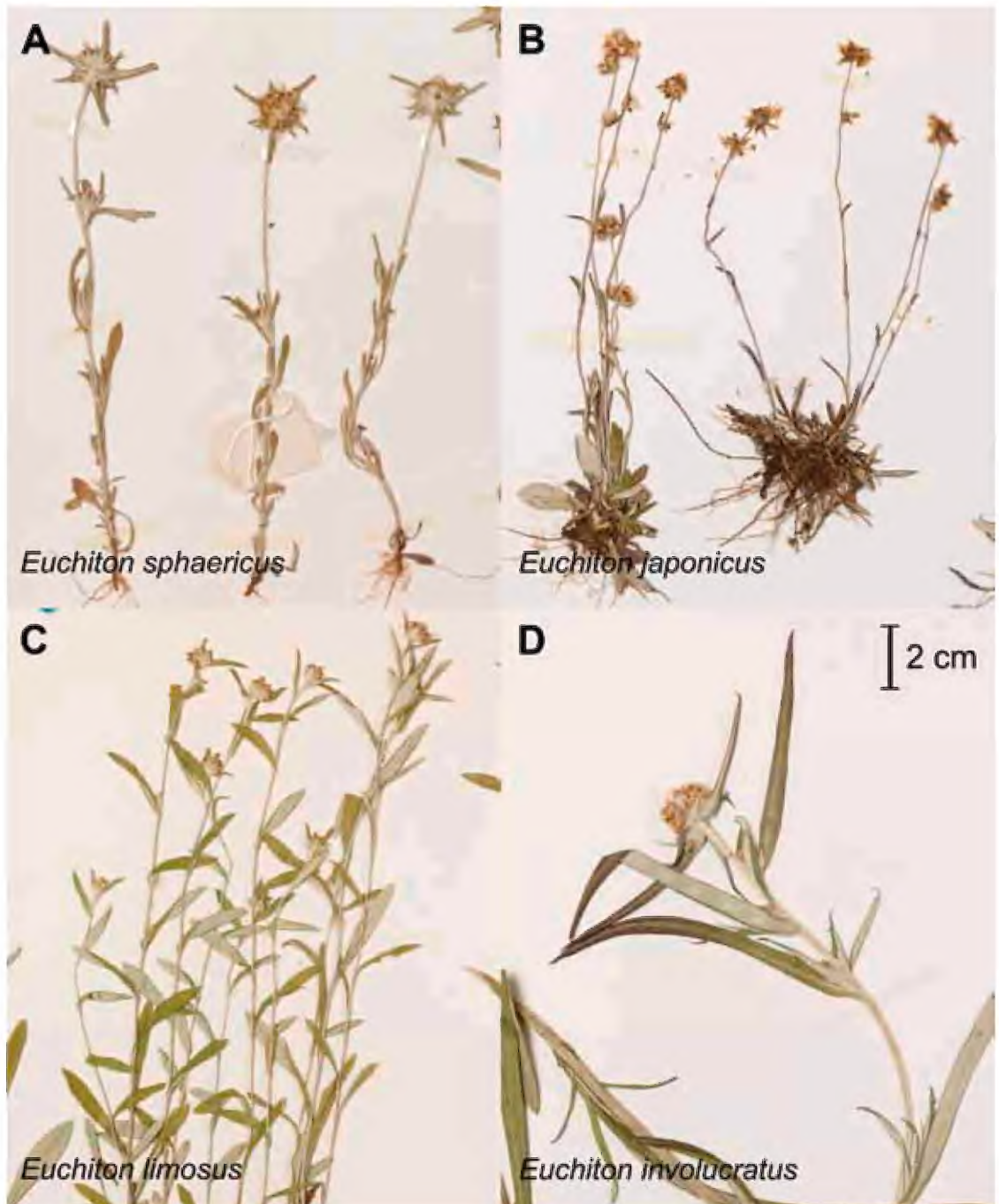


Figure 7. Species with clusters of flowerheads on erect to ascending stems and leaves glabrous or weakly hairy on the adaxial surface. A. *Euchiton sphaericus* (E.M. Canning 4835, CBG7910036). B. *Euchiton japonicus* (B.J. Lepschi 737, CANB425560). C. *Euchiton limosus* (L.G. Adams 3950, CANB376767). D. *Euchiton involucratus* (N.M. Taws 1240, CANB619562). All images are to the same scale.

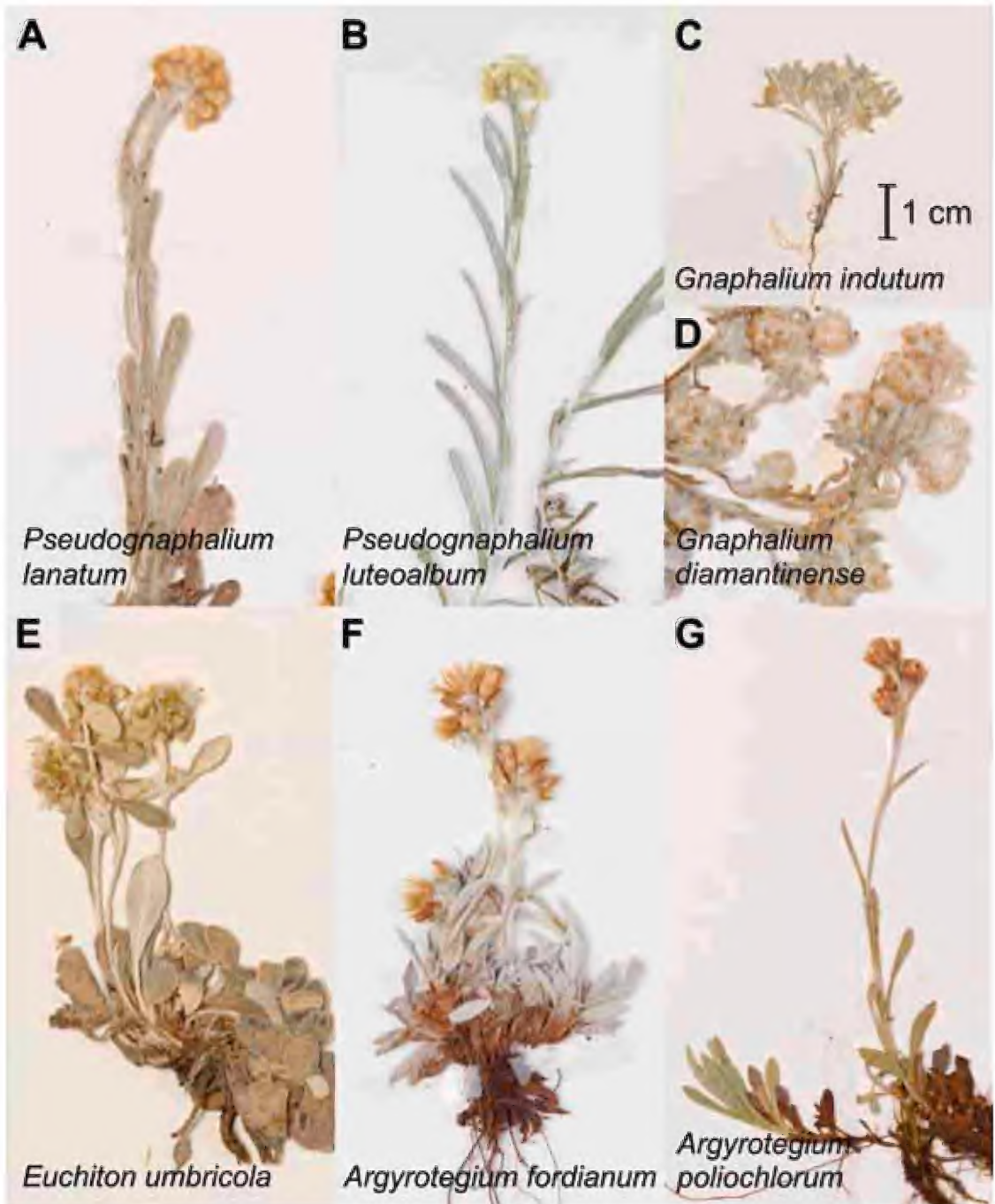


Figure 8. Species with clusters of flowerheads on erect to ascending stems and leaves distinctly hairy on both surfaces. A. *Pseudognaphalium lanatum* (A.N. Schmidt-Lebuhn 1516, CANB813011). B. *Pseudognaphalium luteoalbum* (D.E. Albrecht 15432, CANB909690). C. *Gnaphalium indutum* (P.C. Heyligers 83003, CANB349085). D. *Gnaphalium diamantinense* (R.W. Purdie 8642, CANB811339). E. *Euchiton umbricola* (C. Totterdell s.n., CANB332612). F. *Argyrotegium fordianum* (A.N. Schmidt-Lebuhn 1593, CANB867561). G. *Argyrotegium poliochlorum* (G.T. Wright s.n., CANB578743). All images are to the same scale.



Oxylobium bracteosum (Fabaceae: Mirbelieae), a new species endemic to Mount Imlay in south-eastern New South Wales

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Introduction

The genus *Oxylobium* Andrews is endemic to Australia. In its broadest concept it comprised about 50 species but revisions since 1992 (Taylor and Crisp 1992, Crisp *et al.* 1995, Chandler *et al.* 2002) have assigned most taxa to other genera. There are currently six species recognised in the genus, although *O. oxylobioides* (F.Muell.) Crisp & R.L.Barrett, syn. *Mirbelia oxylobioides* F.Muell., has yet to be taken up by all jurisdictions (e.g., VicFlora 2023). All species are restricted to eastern Australia.

Oxylobium ellipticum (Vent.) R.Br. is one of the most widespread *Oxylobium* species, occurring in New South Wales, the Australian Capital Territory, Victoria, and Tasmania in a range of habitats from near-coastal to alpine. The variety *O. ellipticum* var. *alpinum* Maiden and Betche (1898) was named for low-growing, high-elevation representatives, but is no longer accepted as distinct (CHAH 2011).

McDougall *et al.* (2023) noted that the population of *Oxylobium ellipticum* on Mount Imlay in south-eastern New South Wales differed in its arrangement of flowers and in some leaf characters, and consequently recommended further taxonomic investigation. Following field observations and inspection of 32 collections of *O. ellipticum* at MEL and CANB representing the full known geographic range of this species, the

Abstract

The genus *Oxylobium* has undergone several revisions in the last 30 years with recent works resulting in most previously-recognised species being re-assigned to other genera. One of the few remaining species, *Oxylobium ellipticum*, is widespread in south-eastern Australia, occurring from near-coastal to alpine habitats, and is highly variable in many morphological characters. Collections from the isolated summit of Mount Imlay in south-eastern New South Wales appear distinctive within *O. ellipticum* and, following field and herbarium studies, this entity is herein described as *O. bracteosum* K.L.McDougall & N.G.Walsh. From its low known population size and geographic restriction, the new species is likely to be eligible for listing as threatened.

Keywords: Threatened species, Mount Imlay, Endemic flora

Mt Imlay entity is here elevated to species rank. Also provided are notes on residual forms representing *O. ellipticum* based on author examination of these collections, highlighting the need for further study of this species in particular and the genus *Oxylobium* overall—a task beyond the scope of the present study. The authors have chosen here to focus on the Mt Imlay population, rather than embarking on a lengthy, genus-wide revision in the hope that recognition will enhance conservation outcomes of this highly restricted species.

Taxonomy

Oxylobium bracteosum differs from *O. ellipticum* most distinctively in having flowers in a spicate raceme (rather than a corymb), larger floral bracts (9–11.5 mm long compared with 4–8 mm in *O. ellipticum*) that completely obscure the developing flowers when in bud (Figure 1), and larger bracteoles (9–10 mm long compared with 2.5–5 mm in *O. ellipticum*) that are attached just below the calyx rather than mostly near midway on the pedicel. Other features that are generally distinctive are the decurved rather than straight leaf apices and the longer stipules, when present to 3 mm long versus to 1.5 mm long in *O. ellipticum*. The orange keels of

O. bracteosum flowers (in contrast to red in collections of *O. ellipticum*) may also be diagnostic.

Oxylobium bracteosum K.L.McDougall & N.G.Walsh *sp. nov.*

Type: AUSTRALIA. New South Wales, 20 km SW of Eden, Mount Imlay, near trig., 25.x.1977, *M.D. Crisp* 3504 (holo MEL 05441211; iso CBG!, NSW photo!)

Erect, sparsely-branching *shrub* to 2 m, young stems villous with pale to golden, simple hairs to 2 mm long, overlying a layer of shorter subappressed hairs, older stems with subappressed hairs only, or ultimately glabrescent. *Leaves* crowded, irregularly arranged, or in approximate whorls of 3, narrowly ovate to narrowly obovate or oblong elliptic, 11–25(–40) mm long, 2.5–8(–11) mm wide, reticulate and tuberculate with scattered to dense silky hairs on adaxial surface when young, finally glabrous, abaxial surface densely covered with silky appressed to sub-appressed hairs; margins strongly recurved; midrib depressed on upper surface; leaf apex decurved, mucronate, with a firm point to 2 mm long, usually deciduous; petiole to 2.5 mm long, sericeous; stipules (when present) to 3 mm long, sericeous, tapering to a glabrescent tip. *Flowers* in a condensed, spike-like raceme to 3.5 cm long, pedicels silky hairy to 4 mm long; floral bracts narrowly ovate, acuminate, 9.5–11.5 mm long, 3–4 mm wide, abaxially sericeous, adaxially glabrous, completely obscuring the developing flower until just prior to



Figure 1. The habit and distinctive inflorescences of *Oxylobium bracteosum*. a. Inflorescences of *O. bracteosum* prior to anthesis; note the silky floral bracts obscuring the sepals in bud (J.D.Briggs 1959 & D.E.Albrecht, CANB 366966); b. the distinctive spicate inflorescences of *O. bracteosum* on the summit of Mount Imlay. (Photo: Genevieve Wright, with permission)

anthesis, caducous; bracteoles at anthesis narrowly lanceolate to linear, to 9 mm long and 1 mm wide, attached just below calyx. *Calyx* sericeous, 8–9.5 mm long, 3–4 mm wide, teeth more-or-less equal, as long as or slightly longer than tube. *Standard* suborbicular, emarginate, 10–12 mm long (including a claw 3–4 mm long), 9.5–13 mm wide, orange with a red basal flare, wings orange, obliquely obovate, 8.5–10 mm long (including a claw to 4 mm long), ca. 2.5 mm wide, keel orange, 9–10 mm long. *Ovary* silky hairy. *Fruits* and seeds unknown.

Additional specimens examined: NEW SOUTH WALES.

Mount Imlay, no date, *W.L. Morton s.n.* (MEL!, NSW photol!); Mount Imlay National Park. Just below the summit of Mount Imlay on a spur due south, 17.vii.1986, *D.E. Albrecht 2687* (MEL!); Northern end of summit ridge of Mount Imlay, 26.v.2023, *K.L. McDougall s.n. & G.T. Wright* (MEL!); Mount Imlay National Park. 500 m S of summit of Mount Imlay, 17.vii.1986, *J.D. Briggs 1959 & D.E. Albrecht* (CANB!, NSW photol!); Mount Imlay Peak, adjacent to walking track. Mount Imlay National Park, 27.x.2016, *G.T. Wright 465* (CANB!); Mt. Imlay National Park, Mt. Imlay Summit, 16.v.1978, *S.I. Parker s.n.* (CBG!); Mt Imlay, NNE spur just below summit, 15 km directly SW of Eden on walking track, 25.x.1987, *M. Parris 9220* (CANB!).

Distribution and ecology: Known only from the summit area of Mount Imlay near Eden in south-eastern New South Wales between 850 and 880 m above sea level, where it is locally common in sparse woodland dominated by *Eucalyptus sieberi* L.A.S.Johnson. Soils are typically skeletal and plants grow amongst outcropping Devonian sandstone.

Conservation status: *In situ* observations of *Oxylobium bracteosum* satisfy IUCN 3.1 Red List CR (Critically Endangered) Criteria B2ab(v) (IUCN 2012), i.e., the species has an area of occupancy <10 km², is known from a single location, and there has been an observed (albeit small) reduction in mature individuals as a direct consequence of the introduced pathogen *Phytophthora cinnamomi* Rands, which is present within the entire population. All plants were burnt in the bushfire of 2019/20 but resprouting was observed after about six months (McDougall *et al.* 2023).

Notes on *Oxylobium ellipticum sens. strict.*

In examining many specimens of *Oxylobium ellipticum* from across its range, both in the herbarium and the field, considerable variation in morphology was noticed, with some ‘variants’ possibly representing distinct and as yet undescribed taxa or requiring reassignment to

other existing species, the boundaries of which may warrant re-circumscription. For instance, the distinction between *O. ellipticum* and *O. arborescens* R.Br. is sometimes unclear and collections of *O. arborescens* have occasionally been incorrectly determined as *O. ellipticum* or determined as one species at one herbarium and as the other in duplicate collections held elsewhere. Intermediates between these species may occur naturally. Willis, in notes on collections from Mount Bowen in eastern Victoria (MEL515088 and 515089), suggested two forms of *O. ellipticum* were present at the site. MEL515089 seems to be intermediate between *O. ellipticum* and *O. arborescens* in leaf dimensions and floral bract length. It is not known if typical forms of both species are present in this case or in other areas where apparent intermediates occur. The length of the floral bracts (<3 mm in *O. arborescens* and 4 mm or more in *O. ellipticum*) and flower arrangement (mostly few-flowered axillary corymbs in *O. arborescens* and many-flowered terminal corymbs in *O. ellipticum*) seem to be the most consistent characters of difference. The length to width ratio character cited as diagnostic between *O. arborescens* and *O. ellipticum* in the key to *Oxylobium* in the New South Wales Flora Online (2023) does not appear to be discriminatory in all cases.

Collections examined from the Blue Mountains area (CBG3165, CBG6213, CBG6262) and Budawang Ranges (CBG49103), currently held under *Oxylobium ellipticum*, consistently have leaves with cordate bases, which tend to be sparsely hairy on leaf under-surfaces, characters shared with *O. cordifolium* Andrews. The assignment of those specimens to *O. ellipticum* appears to be based on leaf size (to 14 mm long × 8 mm wide in the Blue Mountains collections compared with 8 mm long × 5 mm wide in *O. cordifolium*) rather than other traits, and further investigation of this apparently aberrant form is warranted.

The outlier population of *Oxylobium ellipticum* from Barrington Tops on the Northern Tablelands of New South Wales appears to differ in some characters (e.g. plants to 2.5 m tall with highly discoloured leaves to 28 mm long) from the dense, compact, alpine or subalpine forms of *O. ellipticum* from the Australian Alps and Tasmania, however, little fertile material is available to make a definitive comparison. Further collections are warranted to ascertain how best to treat the Barrington

Tops population.

Barrett *et al.* (2021) noted that further taxonomic work is required on the genus *Oxylobium*. Genomic analyses may assist in delineating boundaries between existing species and potentially elucidating new species. It is hoped that in segregating *O. bracteosum* from *O. ellipticum*, a challenging task is made at least somewhat simpler.

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Goodenia elongata Labill. (Goodeniaceae) is not present in South Australia

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Goodenia elongata Labill. is a low, sprawling herb that is found in sclerophyll forest adjacent to damp situations throughout south-eastern Australia. It was described by Labillardière from Tasmania in 1805. It has long been recorded in Tasmania, New South Wales and Victoria (e.g., Rodway 1903; Dixon 1906; Maiden & Betche 1916; Ewart 1930). More recently, it has also been recorded in South Australia (SA), where it has been listed under the *SA National Parks and Wildlife Act* as Endangered since 2002. The first written report of this species in South Australia appears to be Carolin & Cooke (1986) on the basis of an 1894 record from 'near Cape Jervis' held at the National Herbarium of Victoria (MEL; MEL 25565), and 'a collection from Mt Gambier'. No specimen supporting the latter was located in a search of *Goodenia* collections from the Mount Gambier area held at AD and MEL. However, a likely scenario is that it was subsequently re-determined as *G. geniculata* R.Br., a species common to that area. When growing in damp environments, *G. geniculata* becomes extensively stoloniferous with numerous (seemingly) cauline leaves, and superficially resembles *G. elongata*. These two species have also sometimes been confused in the south-west of Victoria.

Goodenia elongata was later listed for the South-eastern (SE) Region of South Australia in the published 5th edition *Census of South Australian Vascular Plants* (Barker *et al.* 2005) based on a specimen determined in 1992 by D.E. Symon who curated the family Goodeniaceae at the State Herbarium of SA. This listing

Abstract

Keywords: Lanky Goodenia, Lawrence Stephenson, Census of South Australian Vascular Plants

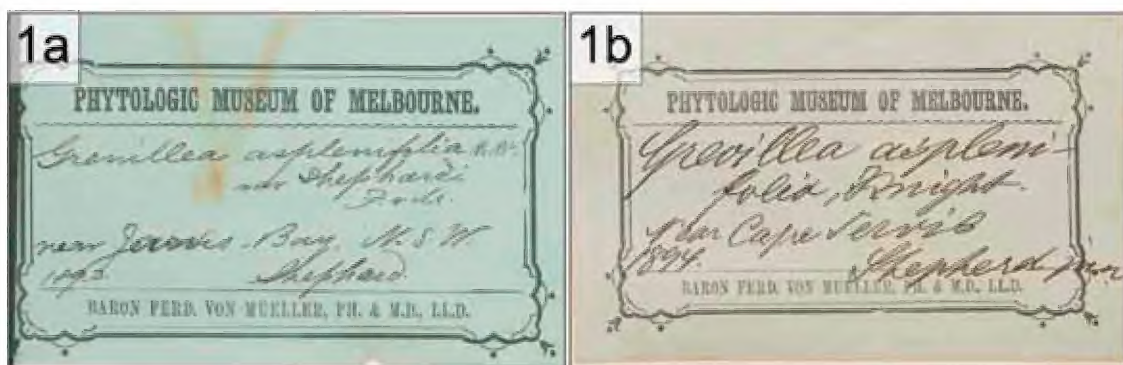


Figure 1. Herbarium labels written by Mueller for specimens of *Grevillea asplenifolia* sent by P.L.C. Shepherd from the Jervis Bay area; 1a. written as 'Jervis Bay' MEL 14280; 1b. written as 'Cape Jervis' MEL 14279. Images reproduced with permission from Royal Botanic Gardens Victoria.

was maintained in the online version of the Census and supported by a second specimen that Symon determined in 2009. The SE listing was removed from the online Census on 4 May 2012 when P.J. Lang redetermined the specimens as *G. pinnatifida* Schltdl. and *G. gracilis* R.Br. respectively.

Inspection of the specimen from 'near Cape Jervis' has confirmed the identity of that record as *Goodenia elongata*, and it includes a determination by R.C. Carolin who revised the genus (Carolin 1990; Carolin 1992). A literal interpretation of the locality implies the historical existence of a very disjunct outlier of *G. elongata* on the Fleurieu Peninsula in SA. However, the collector, Lawrence Stephenson, a botanist from New South Wales, appears to have collected only from the east coast of Australia (see Australian Virtual Herbarium 2024). Stephenson sent specimens to Ferdinand Von Mueller at MEL. Those retained at MEL (including the one cited by Carolin & Cooke 1986) have labels written out by Mueller. It is likely that, in this instance, the label has been erroneously transcribed as Cape Jervis [South Australia] rather than Jervis Bay [New South Wales]. Flora accounts by botanists based at MEL (Ewart 1930; Willis 1972) cited the distribution of *G. elongata* as New South Wales, Tasmania and Victoria. Both would have had access to the specimen MEL 25565 while forming their accounts, so it seems likely that they, too, regarded this as a transcription error by Mueller. Moreover, there is at least one other instance where Mueller has transcribed Cape Jervis for Jervis Bay on specimens held at MEL. Two specimens of the eastern-NSW endemic *Grevillea asplenifolia* Knight were sent

to Mueller by P.L.C. Shepherd in 1893 and 1894. One of these specimens, MEL 14279, has 'Near Cape Jervis' in Mueller's hand on the label, while the second specimen, MEL 14280, is labelled by Mueller as being collected 'Near Jervis Bay' (Figure 1). Given the highly restricted distribution of *G. asplenifolia*, these specimens support the interpretation of Mueller's 'Cape Jervis' as being synonymous with 'Jervis Bay', at least on these labels.

The dubious locality associated with the one verifiable identification of this species for South Australia, together with the lack of any other records since, suggests that it is not, nor has it ever been, present in that state. Accordingly, it is recommended that *Goodenia elongata* be removed from the Census of South Australian Plants, Algae and Fungi and from Schedule 7 (Endangered category) of the SA National Parks and Wildlife Act 1972.

Acknowledgements

We wish to thank Nimal Karunajeewa (MEL) for his assistance with specimens held at MEL and for interpreting handwriting on labels, and to Alison Vaughan (MEL) for offering further evidence of the interpretation of Cape Jervis as Jervis Bay by Mueller.

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Deyeuxia gravida (Poaceae: Agrostidae), a newly described species from Victoria, Australia

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Abstract

Deyeuxia gravida C.G.Taylor & N.G.Walsh is described and illustrated from south-west Victoria. Its morphology is compared to *Deyeuxia quadriseta*, with which it has been associated in the past. Its distribution and ecology are discussed.

Keywords: Taxonomy, Poaceae, Cobboboonee National Park, south-west Victoria, *Pentapogon*

Introduction

Deyeuxia (Poaceae, subfamily Pooideae) is the most speciose of the Australian genera of the tribe Aveneae, currently with 35 species recognised in the country, but circumscription varies (see ‘Generic Placement’ below). As conventionally accepted, the genus occurs mainly in the Southern Hemisphere (Australia, South America, southern Malesia, New Guinea, New Zealand) and comprises some 110 species (Weiller et al. 2009). It is characterised by having single-flowered spikelets with the lemma awned (rarely awnless) and somewhat indurated, of firmer texture than the glumes. The ligule is membranous, truncate or obtuse. *Deyeuxia quadriseta* (Labill.) Benth. is the most widespread species of *Deyeuxia* in Australia, occurring in all jurisdictions except the Northern Territory. It has long been known to incorporate a wide range of variation. Vickery (1940) outlined eight informal entities within the species with very brief diagnoses of them, citing a few representative examples and formally naming *D. quadriseta* var. *cylindrica*, restricted to Western Australia. Neither that variety nor any other of Vickery’s other novelties within the species have been upheld to date.

Walsh (1992) drew attention to a ‘noteworthy variant’ with ‘rather weak, slender culms, flaccid leaves and narrow, depauperate panicles with very small spikelets (barely 3 mm)’. This variant was reported to occur on Wilsons Promontory and the far east and south-west of the state. To investigate the validity of this proposed variant, and others previously proposed by Vickery (1940), a phenetic analysis of specimens was made of

Deyeuxia quadriseta from the collection in the National Herbarium of Victoria (MEL).

Methods

Approximately 200 herbarium specimens of *Deyeuxia quadriseta* at the National Herbarium of Victoria (MEL) were selected to cover the geographic range of the species in south-east Australia, with representative specimens from Victoria, Tasmania, New South Wales and South Australia. Vickery's (1940) vouchers for her informal entities were used where represented by specimens at MEL. From specimens cited by Vickery, it seems she had no material of the Walsh (1992) variant at hand.

The initial dataset employed 19 qualitative or quantitative floral and vegetative characters (Table 1). Character choice was informed by those emphasised by Vickery (1940) and those characters most commonly used to distinguish between species of *Deyeuxia* in Australia (e.g., Jacobs & Hastings 2023; Weiller et al. 2009; Walsh 1992). Following scoring of the morphometric characters, incomplete cases were removed from the analysis, reducing the sample size to $n = 163$.

Based on the broad description of the variant outlined by Walsh (1992), a second dataset of character parameters, including qualitative characters less often employed in *Deyeuxia* species demarcation, were applied to a subset ($n = 71$) of the original specimen set, concentrating on fine-leaved and narrow-panicked specimens (Table 1). Although informative, three characters were removed from the analysis due to too many missing cases (Table 1).

All analyses were conducted using R software (R Core Team, 2022). Pairwise dissimilarities using Gower's coefficient were used to construct a dissimilarity matrix (Gower, 1971). The Gower metric is useful for data which contain both binary and numeric variables through range standardisation of the data. Non-metric multidimensional scaling (NMDS) ordination was used to look for patterns in the data using the *vegan* package (Oksanen et al. 2022). Hierarchical cluster analysis was also performed (with the average-linkage method to incorporate outliers) using the *cluster* package (Maechler et al. 2022).

Kruskal Wallis tests were conducted to determine the effect size (H -statistic) of individual variables to

distinguish between the groups determined by cluster analysis in the second data set. The H -statistic indicates the effect size of each character's ability to distinguish between the two groups. Scores closer to 1 indicate more effective characters and are only shown for those found to be significantly different.

Results

No clearly demarcated clusters, reflecting any of the eight informal groups within *Deyeuxia quadriseta* outlined by Vickery (1940), were apparent from the first dataset ordination or cluster analysis (results not shown).

The second dataset analysis retrieved a distinct group of specimens, consistent with Walsh's (1992) variant (Figure 1). Qualitative characters better distinguished between the two groups with all quantitative characters yielding a H -statistic of <0.5 .

Discussion

Walsh's variant was virtually restricted to a small area of far south-west Victoria with one outlier in the Otway Ranges (Figure 2). The most important characters in separating Walsh's variant from the remaining specimens were a strongly 2-keeled palea that was equal to or longer than the lemma, shorter callus hairs, a plumper caryopsis that caused the palea to bulge somewhat ventrally, and the lemma having strongly raised nerves either side of the midline (Figure 3). The separation of these specimens was primarily based on these binary qualitative characters. Quantitative characters were less informative as Walsh's variant typically sat within the range of *D. quadriseta* due to this species' highly variable form (Table 2). Qualitative characters related to seed morphology are also more likely to be taxonomically informative as they are conserved in species across different environments, whereas differences in vegetative characters likely reflect phenotypic plasticity in response to differing environments (Frazee & Marquis, 1994; Villellas et al., 2021).

Subsequent fieldwork in Cobboboonee National Park showed Walsh's variant to be locally common, but highly ecologically restricted to the margins of seasonally wet depressions (Figure 4). 'Typical' *Deyeuxia quadriseta* (including some relatively fine-leaved and narrow-panicked forms) was sometimes encountered in

the same general area but occupying a broader range of habitats than the variant. Specimens collected in the course of this fieldwork were lodged at MEL and included in the analyses.

On the basis of morphological characters and a very distinctive ecology, Walsh's variant is here circumscribed at species rank as *Deyeuxia gravida*. Although only 13 of the more than 300 *Deyeuxia quadriseta* specimens

housed at MEL conform to *D. gravida*, it is likely that this species is more widely distributed than currently known. Despite their superficial similarity (mainly in habit and inflorescence structure), specimens from Wilsons Promontory and a few other near-coastal sites proved not to be *D. gravida* but rather depauperate individuals of *D. quadriseta* with floral morphology typical of that species. Whether this development is

Table 1. Qualitative (Ql) and quantitative (Qn) characters scored for phenetic analyses of the second dataset. *H* statistics approaching 1 indicate greater cluster differentiation. Characters added in the second round of scoring are indicated by †. Characters excluded from analysis due to poor coverage indicated by *.

Character definitions	Variable type	H statistic
Maximum width of last or penultimate flag leaf (mm)	Qn.	0.311
Length of last or penultimate flag leaf (mm)	Qn.	...
Panicle width at widest point (mm)	Qn.	0.452
Panicle length (mm)	Qn.	...
Culm diameter in last internode (mm)	Qn.	0.461
Length of last or penultimate ligule (mm)	Qn.	0.304
*Plant height (cm)	Qn.	
Inflorescence and seed characters		
Awn attachment point on lemma, measured from tip of callus (mm)	Qn.	0.341
Total length of awn (mm)	Qn.	0.307
*Anther length (mm)	Qn.	
Lower glume length (mm)	Qn.	0.447
Length of lemma, measured from tip of callus to the lemma apex, inclusive lemma teeth (mm)	Qn.	0.406
Maximum callus hair length (mm)	Qn.	0.459
Panicle interrupted (0) or completely continuous (1)	Ql.	0.241
†Many overlapping spikelets tightly condensed into panicle (0) or panicle sparse (1)	Ql.	0.827
†Lemma nerves raised (0) or lemma surface uniform (1)	Ql.	1
†Lemma scabrous along nerves (0) or not evident, lemma surface may be scabrous all over (1)	Ql.	1
†Callus hairs prominent (0) or inconspicuous and seemingly appressed to lemma (1)	Ql.	1
†Palea exceeding or subequal to lemma (0) or palea shorter than lemma (1)	Ql.	1
†Palea nerves raised either side of the midline (0) or evident but not raised (1)	Ql.	1
†Palea scabrous along nerves (0) or not, palea nerves may not visible (1)	Ql.	1
†*Caryopsis deeply grooved along whole length (hilar groove) (0) or not (1)	Ql.	
Ratios		
Ratio of callus hair length to lemma length	Qn.	0.369
Ratio of awn length to lemma length	Qn.	...
Ratio of awn attachment point to lemma length	Qn.	...
Ratio of glume length to lemma length	Qn.	...
Ratio of panicle width to length	Qn.	0.413

merely a phenotypic response or has some genetic basis was not explored during the current study. The occurrence of *D. gravida* in the Otway Ranges is disjunct from the 'core' area of occurrence, inviting further survey of similar sites in the Otways and any intervening areas of apparently suitable ecology.

Taxonomy

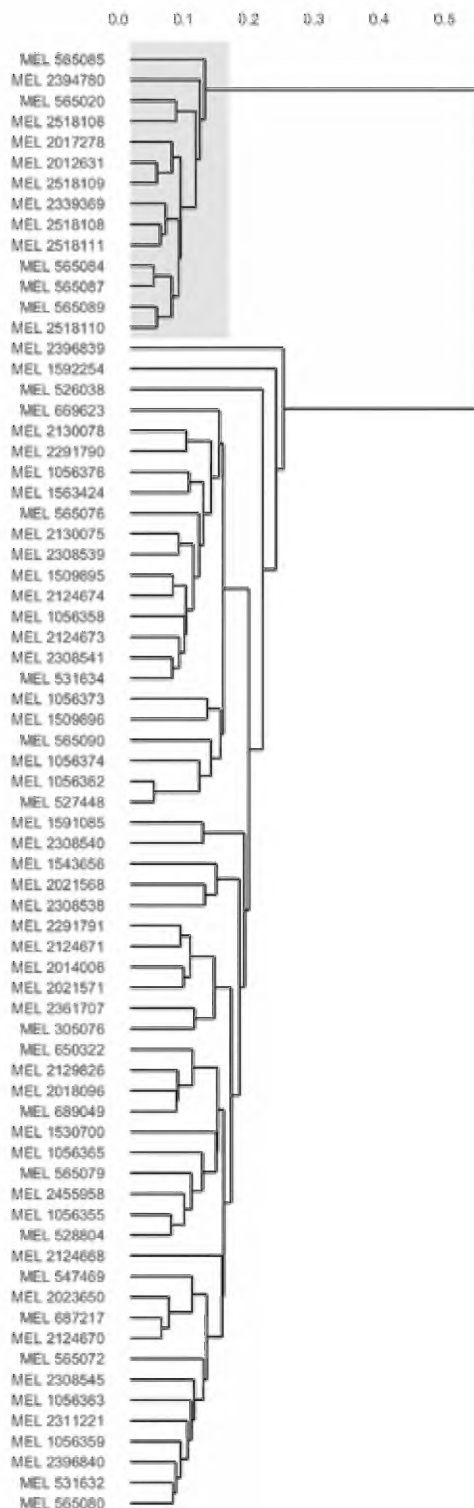
Deyeuxia gravida C.G.Taylor & N.G.Walsh sp. nov.

Type: Australia. VICTORIA, Cobboboonee National Park, beside Mt Deception Rd, c. 300 m E of its junction with Wrights Swamp Rd, 16 km W of Drumborg, C.G. Taylor 2 and N.G. Walsh, 17 Feb. 2022. Holo: MEL 2518109; Iso AD, CANB, HO, K, NSW, US (Figure 5).

Weakly caespitose annual (perhaps more long-lived through sequential wet years), *culms* decumbent to ascending, to c. 60 cm long. *Leaves* soft-textured, rather flaccid, $\pm$ smooth to slightly scabrous; *blade* flat or weakly channelled, to c. 20 cm long and 3 mm wide; *ligule* obtuse, 1–3 mm long. *Inflorescence* a slender, contracted panicle with $\pm$ appressed branches, c. 2–15 cm long, 1.5–6 mm wide, often slightly interrupted. *Spikelets* 2.3–3.4 mm long, green at anthesis; *glumes* acute, sub-equal, scabrous along the keel, gaping about the lemma; *lemma* shorter or subequal to glumes, 1.9–2.9 mm long, ovoid, minutely to strongly scabrous along whole length and the nerves, hardly thickened, but the 5 nerves prominently raised, entire or microscopically 4-toothed at the apex, awned just above the callus; *callus* hairs not uniform with some reflexed, less than a quarter the length of the lemma; rachilla bristle absent. *Awn* 2.5–3.8 mm long, geniculate, twisted in lower part and typically exceeding lemma; *palea* 1.8–2.5 mm long, sub-equal to the or sometimes exceeding the lemma or, strongly 2-keeled and visible between lemma margins at maturity.

Specimens examined: VICTORIA. Cobboboonee State Forest, beside Coffeys Lane c. 1.6 km SE from its junction with Jackeys Swamp Rd, 9.5 km SW of Heywood, N.G. Walsh 9289 & C.G. Taylor, 17.ii.2022 (MEL). Cobboboonee Forest Park, beside Coffeys Lane c. 1.5 km ESE from its junction with Jackeys Swamp Rd, 9.5 km SW of Heywood, C.G. Taylor 1 & N.G. Walsh, 17.ii.2022 (AD, CANB, HO, MEL). Cobboboonee National Park, beside T&W Rd, 2.1 km S of Baggate Rd, 6.4 km WNW of Lyons, C.G. Taylor 3, N.G. Walsh & D. Pitts, 17.ii.2022 (AD, CANB, MEL, NSW). Lower Glenelg National Park, Cordover Swamp, c. 500 m

Figure 1. Dendrogram from hierarchical cluster analysis of the second data set: *Deyeuxia gravida* (grey highlight); *Deyeuxia quadriseta* (no highlight).



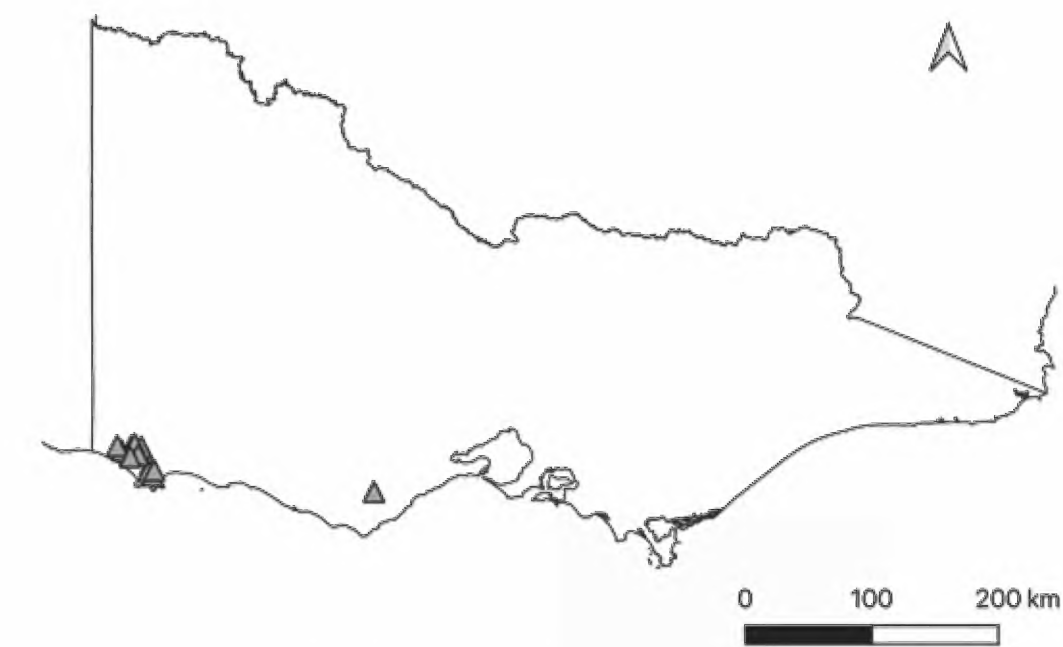


Figure 2. Currently known distribution of *Deyeuxia gravida*.

SE from junction of Baggate Rd and Liddles Lane, c. 4 km SE of Drik Drik, C.G. Taylor 4, N.G. Walsh & D. Pitts, 17.ii.2022 (AD, MEL). Off Westwoods Tk, c. 300 m E of Barongarook-Gerangamete Rd, and 200 m south of the track. 5.2 km SE of Barongarook, N.G. Walsh 6948 & G.W. Carr, 7.i.2010 (BRI, MEL). Cobboboonee National Park, Cut out Dam Rd, c. 1.2 km W of Jackys Swamp Rd, A. Messina 957, N.G. Walsh & D. Pitts, 7.i.2016 (K, MEL). Connover

[Cordover] Swamp (also known as Red Gum Swamp), SE of Drik Drik, D.E. Albrecht 5160, I.C. Clarke & S.A. Day, 3.xii.1992 (MEL, NSW). Unnamed circular swamp c. 5.5 km due SE of Greenwald, D.E. Albrecht 4729, 15.ii.1991 (MEL). Portland, off Portland-Nelson Road, c. 6 miles from Portland P.O., A.C. Beaglehole 1725, 1949 (MEL, NSW). Portland area, Gorae, south of Holmes' property, A.C. Beaglehole 1569, 15.i.1950 (MEL, NSW). Lower

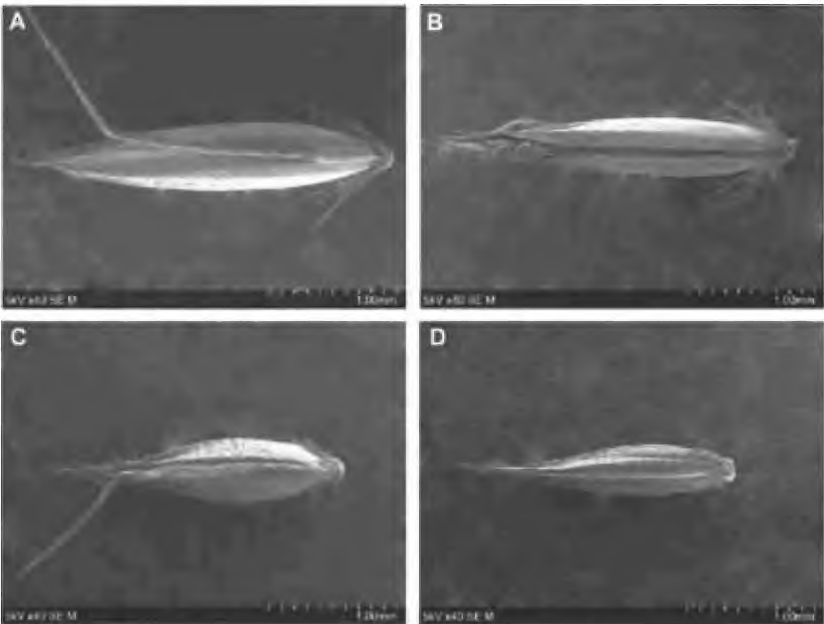


Figure 3. Scanning electron microscope images of typical *Deyeuxia quadriseta*. A. dorsal view of lemma with awn attachment; B. ventral view of lemma. *Deyeuxia gravida*. C. dorsal view of lemma with awn attachment; D. ventral view of lemma.

Glenelg National Park, Red Gum Flat, south of Greenwald. A.C. Beauglehole 42570, 28.xii.1964 (MEL). Far South West district. Lower Glenelg River area, Tremaine Swamp, A.C. Beauglehole 42482, xii.1954 (MEL, NSW).

Habitat: Margins of seasonally inundated pools and swamps (Figure 4). Soil mostly sandy with a high organic component. Typically, associated species include *Eucalyptus ovata* Labill., *Acacia melanoxylon* R.Br., *Coprosma quadrifida* (Labill.) B.L.Rob, *Gratiola peruviana* L., *Lobelia beaugleholei* Albr., *L. pedunculata* R.Br., *Ornduffia umbricola* (Aston) Tippery & Les, *Hookerchloa hookeriana* (F.Muell. ex Hook.f.) E.Alexeev, *Juncus procerus* E.Mey., *Carex appressa* R.Br., *Cyperus lucidus* R.Br., *Lepidosperma laterale* R.Br., *L. longitudinale* Labill. Soils are primarily derived from Quaternary sands of varying depth overlying basalt of the newer volcanics. At the Cordover Swamp site (Figure 4b), the plant community is dominated by *Eucalyptus camaldulensis* Dehnh. rather than *E. ovata* and the soils are less freely draining with apparently shallower sand, promoting a dense ground layer of *Sphagnum novozelandicum* Mitt.

Distribution: Known with certainty only from far south-western Victoria in the Cobboboonee and Lower Glenelg National Parks, with an outlying easterly occurrence in the Otway Ranges near Barongarook. The species is likely to occur in South Australia, but it is currently not known from there. A review of specimens held at AD did not identify any immediate matches for *D. gravida* (P. Lang pers. comm.).

Conservation Status: It is likely that there are numerous populations yet to be discovered within the Cobboboonee National Park—there is limited access by road to areas that contain what seems to be preferred habitat. For an assessment of the species' conservation status (IUCN 2012), we conservatively estimated the number of populations to be ~ 50, with the number of individuals estimated at 5500 (based on a midpoint of between 20 and 200 individuals per population). Population size and extent are likely prone to fluctuation as a consequence of poor survivorship in dry years where the depressions do not hold water for sufficient time or of sufficient depth. The generation length is

Table 2. Character table outlining morphological features most useful in distinguishing *Deyeuxia gravida* from *D. quadriseta*. All measurements are in mm unless stated otherwise.

Character	Species	
	<i>Deyeuxia gravida</i>	<i>Deyeuxia quadriseta</i>
Leaf width	0.7–2.9	0.6–7.8
Panicle width	1.5–6	2.5–35
Culm diameter	0.4–1	0.4–4.6
Ligule length	1.1–2.8	1–7.2
Awn attachment point	0.3–0.5	0.3–1.6
Awn length	2.5–3.8	1.5–6.9
Anther length	0.3–0.5	0.2–2.1
Lower glume length	2.3–3.4	2.6–6.3
Lemma length	1.9–2.9	2–4.9
Callus hair length	0.3–0.5	0.5–1.5
Ratio of callus hair length to lemma length	15–20 %	15–40 %
Ratio of panicle width to length	5 %	5–40 %
Panicle	Sparse	Dense with many overlapping spikelets
Lemma	Raised scabrous nerves	Lemma surface uniform
Palea	Palea bulging at maturity to expose raised and scabrous keels between lemma margins	Palea hardly visible between lemma margins



Figure 4. Habitat of *Deyeuxia gravida*. A. occurring at the margins of seasonally inundated pools dominated by *Eucalyptus ovata*; B. *Eucalyptus camaldulensis* swamp with *Sphagnum novozelandicum* dominating the ground cover (Photo David Pitts).

one year, although in consecutive wet years this could be higher. Extent of Occurrence was calculated at c. 150 km² for the Cobboboonee NP and Cordover Swamp sites, but, if the single Otways site is included, it expands to c. 1600 km². The Area of Occupancy is estimated to be 100 km² applying IUCN recommended 2 km grid size per occupied site.

The quality of habitat is likely to decline over time as a consequence of climate change, with projections suggesting reduced winter and spring rainfall in the order of 5 % and increased annual temperature of 1.9 °C by 2050 (CSIRO and Bureau of Meteorology, 2022).

Applying these mostly conservative assumptions, *Deyeuxia gravida* satisfies the IUCN 3.1 Red List EN (Endangered) Criteria B1bc (ii, iii, iv, v) + B2 bc (ii,iii,iv), i.e. the species has an estimated Extent of Occurrence (EEO) of <5000 km² and Area of Occupation (AOO) of <500 km² and a projected reduction in EEO, AOO, quality of habitat, number of subpopulations and number of individuals.

Etymology: The epithet is a Latin term meaning heavy or pregnant, a reference to the plump caryopsis that gives a ventrally distended appearance to the floret when ripe, a feature that distinguishes it from similar species like *Deyeuxia quadriseta*.

Notes: *Deyeuxia gravida* appears most closely related to *D. quadriseta* with which it shares characters of more or less cylindrical inflorescence, florets lacking an obvious rachilla extension and an awn inserted

in the lower one-third of the lemma. It differs from *D. quadriseta* most significantly in the strongly nerved lemma and palea, and in the plump caryopsis that causes the palea to protrude as the caryopsis ripens. It differs further in the palea being often longer than the lemma, the more strongly scabrous surface of the lemma, and the non-uniform callus hairs. The lemma apex of *D. quadriseta* is typically 4-toothed, and sometimes conspicuously so with teeth approaching 1 mm long. It is this characteristic to which the epithet 'quadriseta' (= four bristles) refers. The lemma apex of *D. gravida* is either entire or microscopically 4-toothed. While there is some overlap in overall spikelet size, *D. gravida* (2.3–3.4 mm) overlaps the lower end of spikelet size range for *D. quadriseta* (2.6–6.3 mm). While the inflorescences are generally shorter and finer than those of *D. quadriseta*, there is overlap in this character. Even with the separation of *D. gravida* from *D. quadriseta*, the latter remains a very variable species. In overall shape and texture, the lemma somewhat resembles that of *D. minor*, but that species has the lemma longer than the palea, the awn inserted at or above 1/3 from the lemma base, and has the lemma scabrous only below midway.

Generic Placement: Saarela et al. (2017), using analysis of ITS sequence data, included most *Deyeuxia* species, including all Australasian ones, within a broadly circumscribed *Calamagrostis*. Subsequently, Peterson et al. (2022), employing a refined analysis of ITS and plastid sequences, reconsidered the speciose



Figure 5. Holotype of *Deyeuxia gravida* (MEL 2518109).

genus *Calamagrostis sens. lat.*, placing Australasian species (*sensu* Saarela *et al.*) in a distinct subtribe (Echinopogoninae) and including Australasian *Deyeuxia* (and *Dichelachne*) species into an expanded *Pentapogon*. They recognised a distinct, largely Northern Hemisphere subtribe (Agrostidinae) that included the bulk of *Calamagrostis* (as well as *Agrostis* and other closely related genera, e.g., *Lachnagrostis*). New combinations in *Pentapogon* were made for species of *Deyeuxia* and *Dichelachne* included in their molecular analysis, but not for the majority of species, as the authors preferred to leave this task to Australasian botanists. In New Zealand, de Lange and Schmid (2022) have made the necessary combinations into *Pentapogon* for relevant taxa in that country. The transfer of Australian species of *Deyeuxia* and *Dichelachne* into *Pentapogon* may follow, but to date, there has been resistance to this change by Australian botanists, and the Australian Plant Census (2024) has yet to take up the new combinations already published in *Pentapogon*. Without consensus amongst Australian agrostologists, it is beyond the scope of the current study to make the combinations required for the residue of Australian *Deyeuxia* as currently accepted.

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Circumscribing *Propolis farinosa* (Fungi, Ascomycota) I: Typification and notes on the identity of *Propolis alba*, a synonym

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Introduction

Propolis farinosa (Pers.) Fr. is the type of *Propolis* (Fr.) Corda (Leotiomycetes, Marthamycetales), a widespread and commonly occurring apothecial fungus that is associated with numerous species of woody plants (Fig. 1). A presumed saprobe, *P. farinosa* produces apothecia that are erumpent through wood, bark, and seed cones of *Pinus* species. Although small, a gregarious fruiting of *P. farinosa* can be conspicuous to the naked eye. A developing apothecium is immersed within plant tissues, with the hymenium covered by a layer of fungal and dead plant tissues. At maturity, the hymenial elements become turgid, and this action forces the covering layer to split open irregularly and bend back to expose the hymenium. This results in the covering layer becoming a projecting, ragged-edged, reflexed structure that surrounds the exposed hymenium, which we term “marginal flaps” or simply, “flaps”. The flaps are somewhat delicate and in some specimens they may be broken off at the level of the surface of the hymenium. Another distinctive feature of *P. farinosa* is a $\pm$ thick, farinose layer that covers the surface of the hymenium (pseudoepithecium). This ranges in colour from stark white to cinereous grey or dingy tan. The inner surfaces of the flaps are dark brown to black and $\pm$ covered in a light dusting of farinose material. Apothecia do not have an excipulum; rather, the subhymenium is seated directly on degraded plant cells. Paraphyses are filamentous with apices that are immersed in the farinaceous substance and somewhat contorted or with short branches. Asci are cylindric-clavate with undifferentiated apices. When immature the ascus wall is somewhat laterally thickened but thinner at the tip. In mature, turgid asci, the apex becomes dome-like and the ascus wall $\pm$ uniformly thin. No

Abstract

To circumscribe *Propolis farinosa* (Pers.) Fr., type of the taxonomically understudied genus *Propolis* (Fr.) Corda, we investigated the nomenclature and taxonomy of the synonym *P. alba* (Fr.) Fr. The basionym of *P. alba* is *Stictis alba* Fr., which has not been typified. We located original material in the form of specimens that are composed of white, powdery, crystalline bodies on rotten wood. We did not observe fungal reproductive structures, tissues, or spores in the materials that we examined. Here, we lectotypify *S. alba*, describe the type specimen, and conjecture as to the origin of the crystalline bodies. We conclude that *S. alba* is not a fungus and therefore not a heterotypic synonym of *P. farinosa*.

Keywords: *Dactylospora*, Elias Magnus Fries, fungal nomenclature, fungus exsiccatae, history, mycology, *Scleromyceti Sueciae*, *Sclerotium*, typification

part of the ascus reacts in iodine-based reagents, even after pretreatment in 10% KOH. Ascospores are smooth, aseptate, and cylindric with obtuse poles, and are slightly curved or occasionally straight. In a living ascospore, two large guttules flank the nucleus that is in the middle of the spore (Bellemère 1967: 428–433, Chlebická 2014, Minter 2019).

The circumscriptions of *Propolis* and *P. farinosa* are unclear due to a lack of critical examination of type materials. Minter (2003) produced a nomenclator of *Propolis* based on literature research that provided an exhaustive list of names in the genus, but with a broad-sense circumscription of *P. farinosa* that contained several synonyms. Research by Chlebická (2014) and our preliminary studies indicate that some of these proposed synonyms represent distinct species. A revised circumscription of *P. farinosa* will clarify the definition of this species and refine our current understanding of its distribution and ecology. It will also facilitate the identification of new taxa in *Propolis*, which we believe is more diverse than previously thought.

One species that was listed as a synonym of *P. farinosa* in Minter (2003) is *Propolis alba* (Fr.) Fr. (Fries 1849). The basionym of *P. alba* is *Stictis alba* Fr., which is validly published in Fries ca. 1825, and sanctioned in Fries (1828) (Art. F.3.1. in May *et al.* 2019). *Stictis alba* is a replacement name for *Sclerotium album* DC. (Arts. 6.11 in Turland *et al.* [2018], hereafter cited as *ICN*), a later, illegitimate homonym of *S. album* Schumacher. (Art. 53.1 of *ICN*). Although Fries (1828) did not explicitly propose *Stictis alba* as a substitute name for *Sclerotium album*, it is nevertheless a replacement name because Fries (ca. 1825) cited “*Sclerotium album*. Decand.” (Art. 6.12(a) of *ICN*). *Stictis alba* has not been previously typified.

Here we outline our search for original material of *Stictis alba* and provide a description of the specimen that we designate as lectotype. We also provide an analysis of the literature surrounding *Stictis alba* and our conclusions regarding the application and placement of this name.

Methods

Literature research

We compared the handwriting on specimen labels to handwriting samples of various botanists in Burdet

(1979). This helped us to judge whether the handwriting on a given label was that of a particular mycologist.

Translations of text in French and Latin were made using Google Translate (<https://translate.google.com/>) and dictionaries, as well as Stearn (1992).

Fungarium research

We inquired of or examined materials held at the U.S. National Fungus Collections, Beltsville, Maryland, USA (BPI); Natural History Museum of Denmark/University of Copenhagen (C); Farlow Herbarium of Harvard University, Cambridge, Massachusetts, USA (FH); Conservatoire et Jardin botaniques de la Ville de Genève, Genève, Switzerland (G); Muséum National d'Histoire Naturelle, Paris, France (PC); Academy of Natural Sciences of Drexel University, Philadelphia, Pennsylvania, USA (PH); National Museum, Prague, Czech Republic (PRM); and the Museum of Evolution of Uppsala University, Uppsala, Sweden (UPS).

Other specimen examined

***Propolis farinosa*. UNITED STATES OF AMERICA:** Rhode Island, Providence county, Johnston, Snake Den State Park; 41.8389, -71.536, 111 m elev.; on fallen, decorticated log of *Acer* sp.; 10 Jun 2017; J.M. Karakehian 17061001 (ILLS 00121779).

Morphology

Photomicrographs of specimens were made in a laboratory setting with a Canon EOS 6D digital SLR camera equipped with a Canon EF-S 60 mm or a Canon MP-E 65 mm lens with a ring light. Other macromorphological observations were made using a Motic SMZ-168 stereomicroscope.

Photomicrographs were made using transmitted light microscopy with an Olympus BX51 compound light microscope with 40x, 100x/1.30 oil immersion plan-achromatic objectives together with an Olympus XC50 5.0-megapixel digital camera and Olympus cellSens Standard 1.14 image processing software. Preparations were mounted in tap water, cotton blue stain in lactophenol, or pretreated in 10% KOH, rinsed with tap water, and then mounted in Congo red or IKI. Longitudinal sections of an apothecium of *Propolis farinosa* (ILLS 00121779) were made on an American Optical model 880 sliding microtome with an attached freezing stage (Physitemp BFS-5MP). The apothecium

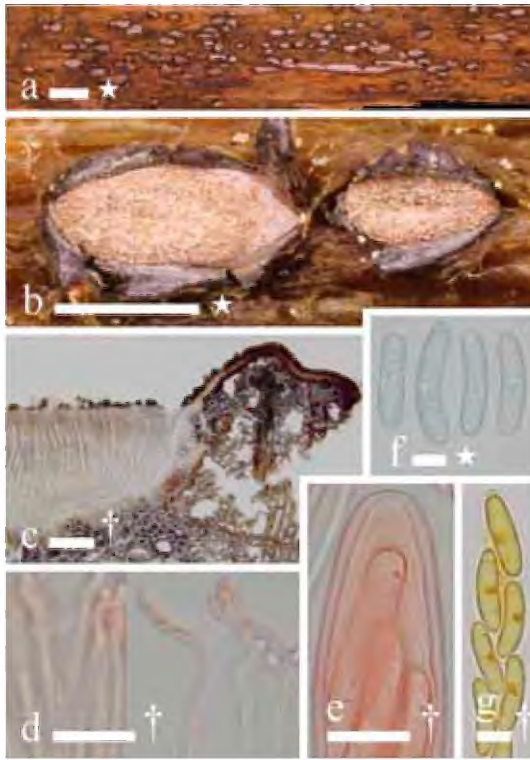


Figure 1. Morphology of *Propolis farinosa*, for comparison to the lectotype of *Stictis alba* shown in Fig. 2. Symbols used: † dead, ★ living. **a** Face view of apothecia in wood (hydrated). **b** Face view of two apothecia showing the erumpent habit and marginal flaps that surround the farinaceous disc (hydrated). **c** Longitudinal section of an apothecium showing apothecial structure and immersion in wood. **d** Apices of paraphyses. **e** Apex of an immature ascus showing immature ascospores and variation in lateral and apical ascus wall thickness. **f** Discharged, mature ascospores, showing nuclei (in the centre of the left two ascospores) and guttulation pattern. **g** Mature ascus with mature ascospores (nuclei stained, guttulation pattern obscured). **Specimen studied:** ILLS 00121779.

Reagents used: **c, f** tap water; **d, e** 10% KOH pretreatment followed by water rinse, then dilute Congo red; **g** as in **d, e** but with IKI. **Scale bars:** **a** 5 mm, **b** 1 mm, **c** 100 µm, **d–g** 10 µm.

was embedded in dilute gum Arabic and sectioned to 15 µm thickness at the middle of the apothecium. Sections were mounted in tap water.

Images were processed in Adobe Photoshop 24.5 and plates made in Adobe Illustrator 27.5. To save space, Fig. 1f is a photomontage.

Results/Discussion

Taxonomy

***Propolis* (Fr.) Corda. Icon. fung. 2: 38 (1838).**

≡ *Stictis* subg. *Propolis* Fr., *Syst. mycol.* 2(1): 192, 198 (1822); nom. sanct. (l.c. 1822: 192).

Type: *Propolis farinosa* (Pers.) Fr. *Summa veg. Scand., Sectio Post.*: 372 (1849).

≡ *Stictis farinosa* Pers., *Mycol. eur.* 1: 339 (1822); nom. sanct. (Fr. *Syst. mycol.* 2(1): 198 1822); nom. cons. prop. (Karakehian *et al.* 2023).

Type specimen: **FRANCE:** Charente-Maritime, Île de Ré, Saint-Martin-de-Ré, Les Marais; 46.190157, -1.353115, 16 m elev.; on decorticated branch, diam 6 cm, still attached to snag of *Populus nigra*; 20 Nov 2022; *Hairaud* MH71122 (ILLIS 001223961, ex-type culture: CBS 149801); typ. cons. prop. (Karakehian *et al.* 2023).

Taxon excluded from *Propolis*.

***Propolis alba* (Fr.) Fr., *Summa veg. Scand. Sectio Post.*: 372 (1849).**

≡ *Stictis alba* Fr. Fries, *Scleromyc. Suec.*, Fasc. 9, decade 34, no. 335 (ca. 1825), nom. nov.; nom. sanct. (Fries *Elench. fung.* 2: 27. 1828).

Replaced synonym: *Sclerotium album* DC. *Fl. franç.*, 3rd edn. 5/6: 112 [no. 744b] (1815), nom. illegit. (Art. 53.1 of *ICN*).

Competing homonym: *Sclerotium album* Schumacher. *Enum. pl.* 2: 186 (1803).

Typification: Lectotype designated here: On decorticated wood of *Acer pseudoplatanus*. *J. F. de Chaillet* no. 235, G 00584953! (MB 10020421).

≡ *Xylogramma album* (Fr.) Wallr., *Fl. crypt. Germ.* 2: 510 (1833).

≡ *Hymenula alba* (Fr.) Corda, *Icon. fung.* 2: 32, Tab. 14, fig. 112 (1838).

Description of lectotype specimen G 00584953 (Fig. 2). Bodies composed entirely of compact, granular crystals; no fungal reproductive structures, tissues, or spores observed. Bodies elliptical or highly elongated, 2–15 × 1–2 mm, convex, chalky white, friable at the outer surface but ± solid below, sessile or immersed in the rotten wood substratum to varying depths, presumably becoming exposed by erosion of the surrounding substratum over time, *crystals* irregular in shape and variable in size, insoluble in water.

Additional original material (Fig. 3a–d): In Fries (ca. 1825), no. 335, issued ca. 1825: C F-109700, UPS (sans number, in bound copy), PRM 735152(?), PH 00083643, BPI 1050201(?).

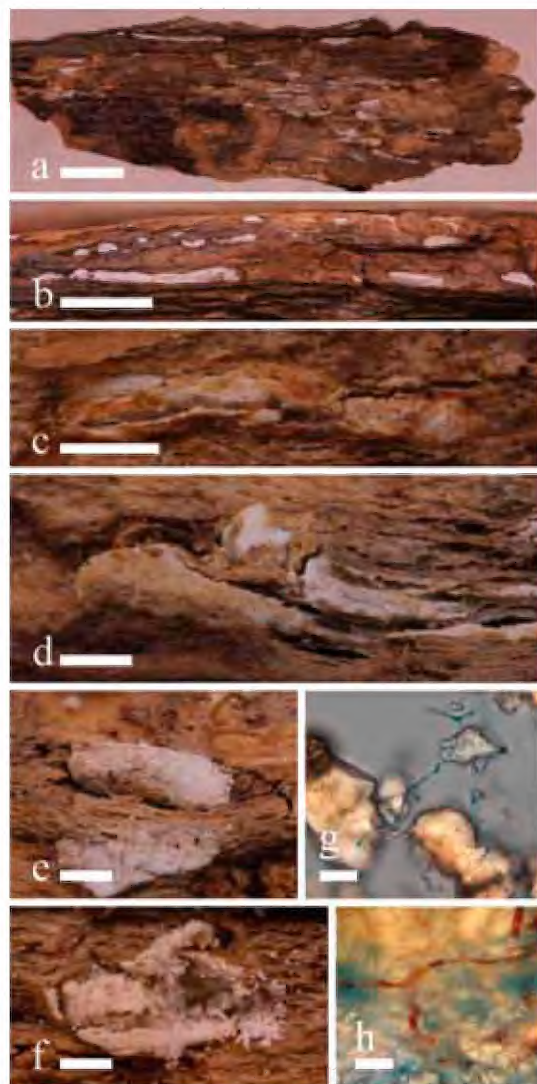


Figure 2. Morphology of the lectotype of *Stictis alba*, G 00584953. **a** Face view of crystalline bodies in wood (dry). **b** detail of crystalline bodies from upper portion of specimen shown in a. **c–e** Details of crystalline bodies with surrounding woody substratum worn away to various degrees. **f** Detail of a crystalline body that has been probed apart on the right side to show the body is composed entirely of crystals and is deeply immersed in the wood. **g** Crystals in cotton blue/lactophenol showing narrow, hyaline hyphae. **h** As in g, but showing somewhat thicker, brown, septate hyphae (blue stained areas are the narrow, hyaline hyphae shown in g).

Scale bars: **a, b** 1 cm, **c–e** 1 mm, **g–h** 20 µm.

Additional specimens examined. SWEDEN: Småland, Halland, Hylte (Femsjö parish), Hägnen; [approximately] 56.898, 13.338, 158 m elev.; (UPS F-543499, UPS F-117771 [both labelled by Fries as *Propolis alba*]) (Fig. 3e–f). Småland, Halland, Hylte (Femsjö parish), Bökeberg; 56.9003, 13.38158, 167 m elev.; in pastureland, on rotten wooden post of undetermined wood; 20 Sept 2023; J.M. Karakehian 23092009 (ILLS 00122483).

Additional notes based on observations of the lectotype and additional specimens. Since the crystalline bodies are not erumpent apothecia, they do not produce marginal flaps like those of *Propolis farinosa* (Fig. 1b–c). When a drop of water is applied to the crystals, it quickly flows through them and into the surrounding substratum, but the crystals themselves are not water soluble. The water does not form droplets on the surface of the bodies as it does on the hydrophobic, farinaceous discs of *Propolis* species. We did not attempt to characterise the chemical composition of the crystals. In the lectotype, we observed two types of hyphae that lacked clamp connections and that were sparsely interwoven among and upon the crystals: hyaline hyphae, approximately 2.5 µm diam (Fig. 2g) and brown hyphae, 3.6–4.2 µm diam (Fig. 2h). The substratum of specimens UPS F-543499 and UPS F-117771 appears to be *Quercus* wood (Fig. 3e–f). Fries (1828) noted that *S. alba* occurred on *Quercus* species in northern and southern Europe. Common oak species in Europe include *Q. robur* and *Q. petraea*. Our colleague at UPS examined UPS F-543499 and found only crystalline bodies with no fungal reproductive structures, tissues, or spores (Åsa Krusys, pers. comm. 9 Aug. 2022). We dissected several exposed crystalline bodies with a probe on specimen ILLS 00122483 and observed that occasionally these continued below the substratum, forming short tubes that ran $\pm$ parallel to the surface of the substratum. We observed hyaline hyphae, 2.2–3 µm diam and lacking clamp connections, associated with the crystals in this specimen. We studied the macromorphology of the additional original materials listed above using images (Fig. 3a–d).

Nomenclatural history: The date of valid publication of *Stictis alba*. While the name *Stictis alba* is sanctioned in Fries (1828), we suspected that it could have been validly published earlier because Fries (1828) cited specimens in his published fungus exsiccata, *Scleromyceti Sueciae*

(Fries ca. 1825). Fries's (1828) citation was minimal, giving only "Fries exs. fasc. IX", which is a reference to fascicle nine of this exsiccata (Fries ca. 1825, Holm &

Nannfeldt 1962, Karakehian *et al.* 2024a). It was only later in 1849 that Fries provided the species number, 335 (Fries 1849). Fortunately, prior to 1849, a reader could have located the distributed collection in fascicle nine that Fries (1828) called *S. alba* because it was labeled as such at the time this fascicle was issued; this was not the case for other of Fries's citations of specimens in the *Scleromyceti Sueciae* (Holm & Nannfeldt 1962, Karakehian *et al.* 2024a [e.g., *S. atrocyanea*]). We verified that *S. alba* was validly published ca. 1825 by examining images of the printed index and a specimen of number 335 (C F-109700) in a complete copy of fascicle nine held at C (Karakehian *et al.* 2024a, Figs. 3–4). The specimen bears an original, printed label that was cut out from a single-sided print of the index (l.c. Fig. 4, Fig. 3a here). Because the index and the label are printed, the name *Stictis alba* is effectively published (Art. 30.8 of ICN). It is validly published because an additional note in the index and label gives "Sclerotium album. Decand.", which is a reference to Candolle's (1815) effectively published description and diagnosis (Art. 38.1 of ICN).

Nomenclatural considerations toward a typification of *Stictis alba*. Because *Stictis alba* is a sanctioned name, it may be typified by the type of the replaced synonym (Art. 7.4 of ICN), *Sclerotium album*, or a lectotype (Art. 9.3 of ICN) may be chosen from elements associated with the sanctioning treatment (Art. F.3.9 in May *et al.*

LEFT: Figure 3. Original material and additional specimens of *Stictis alba* originating from Elias Fries. **a–d** Original material held in various fungaria, from Elias Fries's fungus exsiccata *Scleromyceti Sueciae*, fascicle nine, number 335 (Fries ca. 1825); printed labels were cut out from single-sided prints of the index that was included in the fascicle (cf Karakehian *et al.* 2024a). **e–f** additional specimens. **a** C F-109700, this specimen is part of a bound, complete copy of Fries (ca. 1825) at C (first edn.). **b** UPS (sans number), in an incomplete, bound copy of fascicle nine that is missing printed labels; this copy is a preliminary or "specimen copy" given to Göran Wahlenberg by Fries around 1823 (Holm & Nannfeldt 1962, Karakehian *et al.* 2024a). **c** PRM 735152, presumably from the first edition, loose specimen. **d** PH 00083643, presumably from the first edition, specimen sent to L.D. von Schweinitz by Fries, remounted by E. Michener (Shear *et al.* 1917, Shear & Stevens 1917) **e** UPS F-117771, label written by Fries: "Femsjo in Hagnen. Scl. Suec. 335, ubi meliora specimina [Femsjö in Hägnen. Scleromyceti Sueciae 335, wherein better specimens]." **f** UPS F-543499, label written by Fries: "Hagnen ad Femsjo", the annotation "= Scl. suec. 335" is a later addition. **Images courtesy of:** **a** Christian Lange at C, **c** Markéta Šandová at PRM, **d** Chelsea Smith at PH.



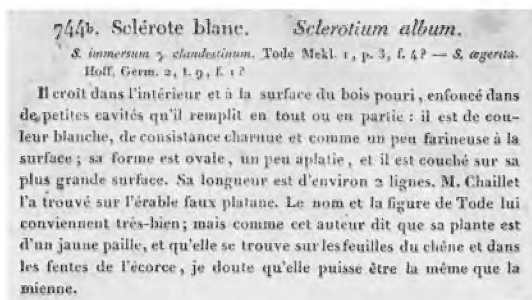


Figure 4. Protologue of *Sclerotium album* DC (Candolle 1815: 112).

2019) that are considered equivalent to original material (Art. F.3.9 Note 2 in May *et al.* 2019). Neither *Stictis alba* nor *Sclerotium album* have a holotype (Art 9.1 of ICN, McNeill 2014) and we found no previous typifications by searching under these names using online fungus name databases (<http://indexfungorum.org>, <https://mycobank.org>), Sherwood (1977: 149), and general internet queries.

Elements cited in the protologue of *Sclerotium album* and in the sanctioning treatment of *Stictis alba*.

No original material in the form of illustrations were cited in the protologue of *Sclerotium album* (Candolle 1815) or in the sanctioning treatment of *Stictis alba* (Fries 1828). We note that Candolle (1815) cited illustrations in Tode (Tode 1790: 3, Tab. 1, Fig. 4) and Hoffmann (Hoffmann 1796: Tab. 9, Fig. 1), but these are not original material because they are doubtfully included and then only for the purpose of comparison to his new species (Art. 52.2, Note 1 of ICN). For ease of reference in the analysis of original materials in the form of specimens that follows, the protologue and sanctioning treatment are reproduced here with English translations (with our editorials given in brackets).

***Sclerotium album* (Fig. 4).**

744^b. *Sclerotium album*.

S. immersum γ *clandestinum*. Tode Mehl. I, p. 3, f. 4? [Tode 1790: 3, Tab. 1, Fig. 4] — *S. aegerita*. Hoff. Germ., 2, t. 9, f. 1? [Hoffmann 1796: Tab. 9, Fig. 1]

It grows in the interior and on the surface of rotten wood, buried in small cavities which it fills in whole or in part: it is white in color, fleshy in consistency and somewhat floury on the surface; its shape is oval, a little flattened, and it lies on its largest surface. Its length is approximately 2 lines [4.2 mm]. Mr. Chaillet found it on the false plane maple [*Acer pseudoplatanus*]. The name and figure of Tode suit it

very well; but as this author says that his plant is of a straw yellow, and that it is found on the leaves of the oak and in the cracks of the bark, I doubt whether it can be the same as mine (Candolle 1815).

No specimens or gatherings are cited in this protologue. However, the information concerning an observation by Jean Frédéric de Chaillet (Stafleu & Cowan 1976) on *Acer pseudoplatanus* could be helpful to identify original material in the form of a specimen.

***Stictis alba* (Fig. 5).**

17. c. *S[tictis] alba*, erumpent, projecting, elongate, immarginate, constantly snow-white, disc convex, farinaceous.

Sclerotium album. Dec.! *Fl. Franc. et in Mem. Mus. d'Hist. Nat.* 1816. p. 411. *Chaillet! in correspondence* (What others, forced by the authority of Wallroth, sent under this name is *Stictis versicolor*). *Stictis alba*. Fries exs. fasc. IX.

And the affinity of this with *Stictis versicolor* is clear, yet the species is clearly different and remarkable, almost in the habit of the sclerotia, especially in the old *superficial* state. It appears floury as a whole, but the texture is flaky and initially there are a large number of genuine asci. There is no limbus [marginal flaps]. The colour is constantly white and becomes more snowy with age, never turning black. *To the oak trees of Europe, both northern and southern.* (v.v. [vidi vivam: I have seen it in a living state]) (Fries 1828).

Fries (1828) cites various elements in this treatment. The exclamation points in "*Sclerotium album*. Dec.!" and "*Chaillet! in litt. [in litteris]*" indicate that Fries had personally examined a specimen from Candolle, as well as correspondence by Chaillet (cf. Fries 1823: [621] ["... to the numerous species of *Chaillet*, ... add – ! ... I have

17. c. *S. alba*, erumpens, prominens, elongata, immarginata, constanter nivea, disco convexo farinaceo.

Sclerotium album. Dec.! *Fl. Franc. et in Mem. Mus. d'Hist. Nat.* 1816. p. 411. *Chaillet! in litt.* (Quod alii, v. c. ob auctoritatem Wallroth, sub hoc nomine miserunt, est. *St. versicolor*). *Stictis alba*. Fries exs. fasc. IX.

Et hujus cum *S. versicolori* affinitas perspicua est, tamen species luculenter diversa et insignis, habitu fere Sclerotii, praecipue in statu vetusto *superficiali*. Farinacea apparet tota, tamen contextus adest floccosus et primitus adsunt asci ampli genuini. Limbus nullus adest. Color constanter albus et senescens magis niveus, numquam nigrescens. *Ad ligna quercina Europae tam borealis, quam australis.* (v. v.)

Figure 5. Sanctioning treatment of *Stictis alba* Fr. (Fries 1828 2: 27).

used this sign in the sense of DeCandolle"], Stearn 1992: 352). Fries also cites specimens distributed as *Stictis alba* in fascicle nine [no. 335] of his *Scleromyceti Sueciae* (Fries ca. 1825).

We are uncertain about our translation of Fries's comment in parentheses about Karl Friedrich Wilhelm Wallroth and *Stictis versicolor*. It may be that Wallroth sent Fries a specimen of *Stictis versicolor* (= *Propolis farinosa*) that was misidentified as *Sclerotium album*: we examined a specimen labelled "*Sclerotium album* DC." written in what may be Wallroth's script in the Fries fungarium at UPS (F-175307) that is *P. farinosa*. It may also be that somewhere Wallroth used the name *Sclerotium album* to refer to what Fries considered to be *Stictis versicolor* and others followed Wallroth's concept and used the name as he had.

We also cannot account for Fries's (1828) statement that the bodies of *Stictis alba* initially contained a large number of asci. Fries thought *S. alba* was similar to *S. versicolor* (= *Propolis farinosa*), but considered it distinct in that the bodies were initially immersed in the substratum, though not erumpent because they lacked marginal flaps ("limbus"), and produced asci. As the bodies aged they became superficial, and the asci were gradually replaced by crystals until the hymenium was entirely farinaceous with a flaky texture. Fries (1832: 468) summarised his wide concept of the hymenium in species of *Stictis*: "It would take too long ... to enumerate all the changes of the disc ... for they can be seen with and without asci, deliquescent, powdery, etc." (in Tulasne & Tulasne 1931 [vol. 1]: 226). Although prior to 1832 Fries did not employ a microscope with any regularity because of the poor quality of the optics at the time (in Fries & Fries 1955: 144, 147), Fries's (1828) observations may be trustworthy. In the protologue of *Sclerotium album*, Candolle (1815) described the bodies as fleshy in consistency and somewhat farinaceous on the surface, and Corda (1838) described a specimen of *Stictis alba* issued in the *Scleromyceti Sueciae* as a conidiogenous fungus. Regardless, we did not observe any fungal tissues, reproductive structures, or spores in the specimens that we microscopically examined. We presume that this is the case with the specimens that we were only able to study images of because these appear to have the same crystalline bodies (Fig. 3a–d). We speculate that Fries may have examined specimens

of *P. farinosa*, which have asci, in addition to those of *S. alba*, which are entirely crystalline, as he prepared his treatment of *S. alba* (Fries 1828).

Account of the original material that we located. The original material that we located through our studies of the protologue of *Sclerotium album* (Candolle 1815) and the sanctioning treatment of *Stictis alba* (Fries 1828) include a specimen of *Sclerotium album* from Chaillet on *Acer pseudoplatanus* that Candolle had studied in preparation of the protologue, and specimens of *Stictis alba*, number 335, issued in Fries's *Scleromyceti Sueciae* (Fries ca. 1825). These are described as follows.

***Sclerotium album*.** The morphology of a specimen in the fungarium at G, G 00584953, agrees with the protologue of *Sclerotium album* and several elements associated with the packet labels (Fig. 6a) suggest it is original material. First, a printed label associates the specimen with the Candolle family herbarium (Fig. 6b) (Stafleu & Cowan 1976: 438). An English translation of this reads: "Given in 1921 to the City of Geneva by Mme Augustin de Candolle and her children. —Series not having been used for the drafting of either the *Prodromus* or the *Monographiae Phanerogamarum*, gathered in the general collection of the Herbar Delessert from 1924". Second, two portions of undated correspondence from Chaillet to Candolle are affixed to the specimen (Fig. 6c), elements of which appear in the protologue. These are transcribed and translated to English as follows:

"*Sclerotium Aegerita*. Hoff.: 2. t. 9. f. 1? Je doute que ce soit cette Plante, mais je ne sais pas où la rapporter et si ce n'est pas celle d'Hoffmann elle s'en rapproche beaucoup. No. 235. *Acer Pseudo Plantanus*"

"*Sclerotium aegerita*. Hoff.: 2. t. 9. f. 1? I doubt it is this plant, but I don't know where to report it, and if it is not Hoffmann's it is very close to it. No. 235. *Acer pseudoplatanus*"

"Sous un No. 235 je vous ai donné l'année dernière une plante sous le nom de *Sclerotium aegerita*? Il me paraît que c'est le *Sclerotium immersum* β *Album* Tode P. 3. La fig: 4 Pl[anche] 1 qui appartient à la Var: clandestina représente assez bien ma Plante."

"Under a no. 235 last year I gave you a plant under the name of *Sclerotium aegerita*? It seems to me that it is the *Sclerotium immersum* β *Album* Tode p. 3. The fig. 4 plate 1 which belongs to the var. clandestina represents my plant quite well."

Third, on the reverse side of a small label bearing "*Sclerotium album* DC. 744b" (the species number of *S. album* in Candolle 1815) (Figs. 6a [lower left element], 6d), there is a fragment of notes in Candolle's script (Fig. 6e), portions of which appear to have been directly adapted to the protologue (parts of lines 2–3 and 6 correspond to parts of lines 5 and 7–9 of the protologue

[Fig. 4]). Finally, there is an annotation by Joseph Henri Léveillé: "Nullum fructificationis vestigium adest [No trace of fruiting is present]" (Fig. 6f). Léveillé may have examined this specimen in preparation for his treatment of the genus *Sclerotium* (Léveillé 1843). The label pinned in the upper left of Fig. 6a with "*Stictis alba*. F." written on it was also written by Léveillé.

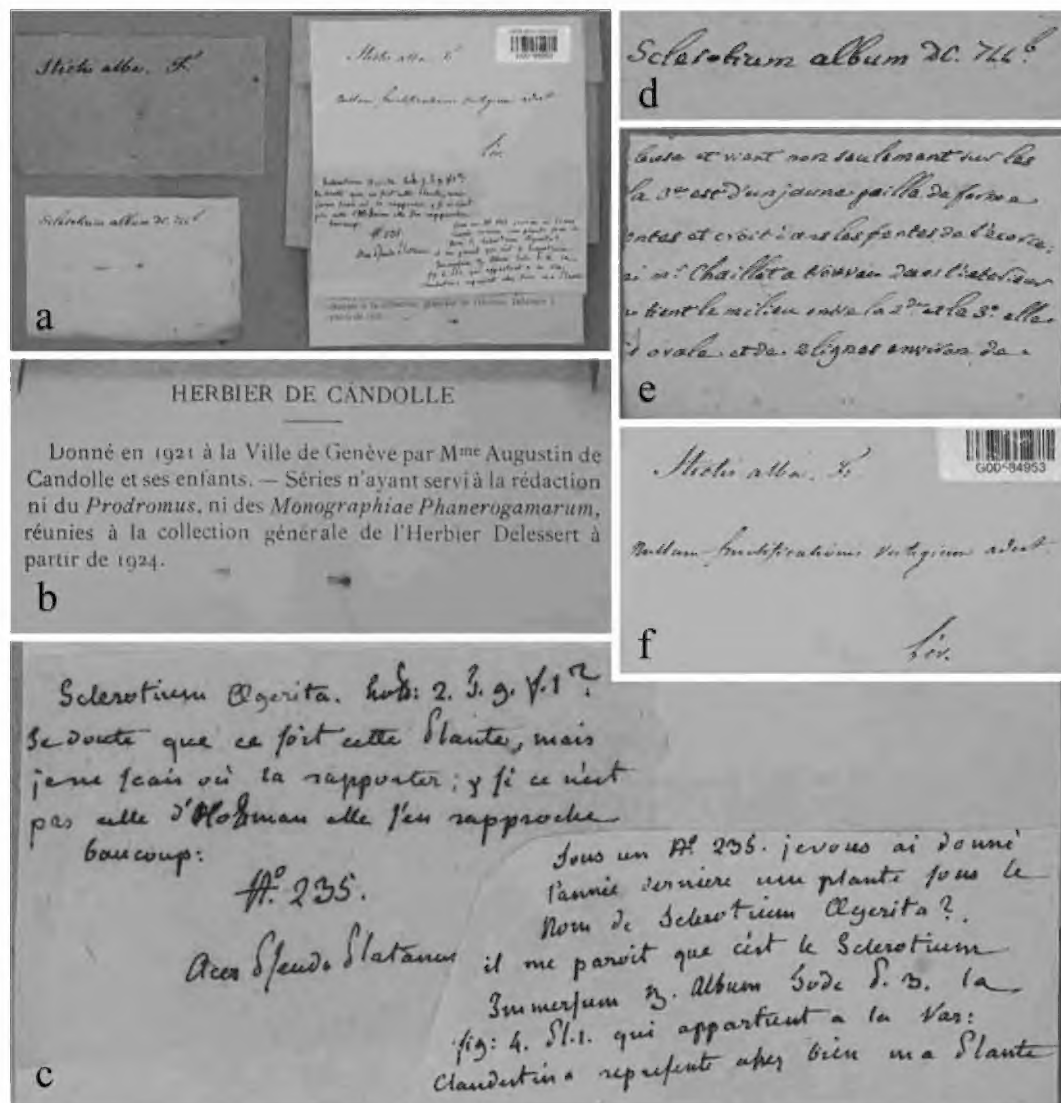


Figure 6. Label information on the lectotype of *Stictis alba*, G 00584953 (*Sclerotium album* DC). **a** Specimen packet and associated elements pinned to herbarium sheet. **b** Detail of printed label shown in a, lower right, giving the provenance of the specimen. **c** Detail of the lower portion of the packet label shown in a, right side, consisting of two portions of undated correspondence from J. F. de Chaillat to A. P. de Candolle, elements of which were incorporated into the protologue. **d** Detail of upper portion of the small label shown in a, lower left. **e** Detail of the reverse side of the small label shown in a, lower left, which is a fragment of notes written by Candolle, from a draft of the protologue because portions of this are copied verbatim in the published protologue. **f** Detail of the upper portion of the packet label shown in a, right side, annotation by J. H. Léveillé: "Nullum fructificationis vestigium adest [No trace of fruiting is present]".

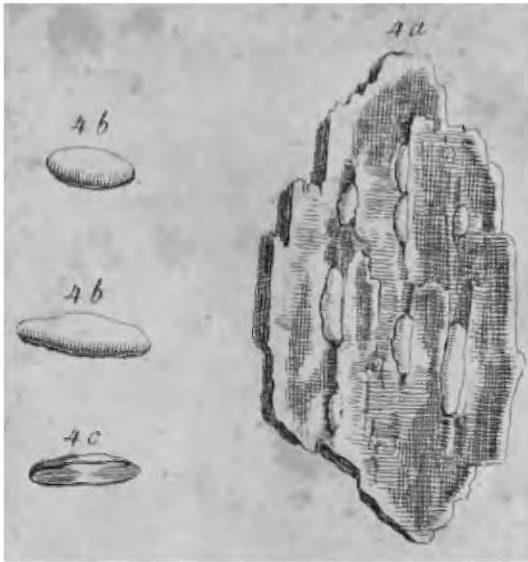


Figure 7. Illustration of *Sclerotium immersum* γ *clandestinum* Tode (Tode 1790: 3, Tab. 1, Fig. 4).

After studying G 00584953, we agree with Chaillet's assessment that this specimen closely resembles Tode's illustration of *Sclerotium immersum* γ *clandestinum* (Fig. 7, from Tode 1790: 3, Tab. 1, Fig. 4). Tode's illustration (Fig. 7, "4a") shows elongate, white bodies in the crevices of the substratum (cf. Fig. 2a–b), and detail drawings of the bodies (Fig. 7, "4b"–"4c") show that they are convex and lack marginal flaps (cf. Fig 2e).

Comparing the notes associated with specimen G 00584953 to the protologue of *Sclerotium album*, we were struck by the possibility that this may be the very specimen that Candolle used to write the description, although we cannot rule out that other material was not also used. We note that Chaillet's collection number, 235, does not appear in the protologue (Candolle 1815).

In the treatment of *Stictis alba*, Fries (1828) indicated that he had personally examined material of *Sclerotium album* from Candolle along with related correspondence by Chaillet. We speculate that the material of *S. album* that Fries studied is specimen G 00584953 because this appears to be a primary, if not the only, specimen that Candolle studied as he wrote the protologue. Furthermore, to our knowledge, it is the only specimen with this provenance that is preserved at G. If this is the case, it is possible that the Chaillet correspondence that Fries referred to is the same as that preserved with this specimen.

***Stictis alba*.** We located several specimens of number 335, *Stictis alba*, issued in Fries's *Scleromyceti Sueciae* (Fries ca. 1825). Because these specimens were cited in the sanctioning treatment (Fries 1828) of this name, they are considered equivalent to original material following Art. F.3.9, Note 2 in May *et al.* (2019). We provide notes on these specimens, as well as some that are not original material, as follows.

Specimen C F-109700 is original material (Fig. 3a). It is from a complete, bound issue of fascicle nine that is part of the first edition of the *Scleromyceti Sueciae* (Fries ca. 1825). The specimen has an original, printed label that was cut out from a single-sided print of the index to this fascicle. Karakehian *et al.* (2024a) provide an overview of Fries's *Scleromyceti Sueciae* with a focus on fascicle nine, along with ample documentation of the copy of this fascicle at C.

A specimen at UPS (sans number) is original material (Fig. 3b). This specimen is in an early draft or "specimen copy" of fascicle nine that Fries gave to Göran Wahlenberg, Swedish botanist at Uppsala University, around 1823. This bound copy was missing the index and ten specimens but is well-documented as authentic by Holm & Nannfeldt (1962), with additional notes in Karakehian *et al.* (2024a).

A specimen at PRM is likely original material (Fig. 3c). Corda (1838: 32) studied a specimen of *Stictis alba*, number 335 and described it as *Hymenula alba* (Fr.) Corda. According to Pilát (1938) there is no specimen of number 335 in the Corda fungarium at PRM. However, we located one specimen, PRM 735152, filed in the general fungarium (Markéta Šandová, pers. comm. 26 May 2023). We examined an image of this specimen and it has a printed label that appears to have been printed on the same type of paper as the label on the specimen at C (cf. Fig. 3a). It is likely that this specimen is from the first edition of the *Scleromyceti Sueciae* (Fries ca. 1825), and not the second (Holm & Nannfeldt 1962, Karakehian *et al.* 2024a), but we are uncertain because the specimen is loose and there are no notes to indicate its history.

A specimen of *Stictis alba* in the Schweinitz fungarium at PH, PH 00083643, is arguably original material (Fig. 3d). Although the specimen lacks any original labels or other notes indicating that it originated from Fries (ca. 1825), there is the notation "Suecia" [Sweden] indicating that the specimen likely came from Fries. Schweinitz

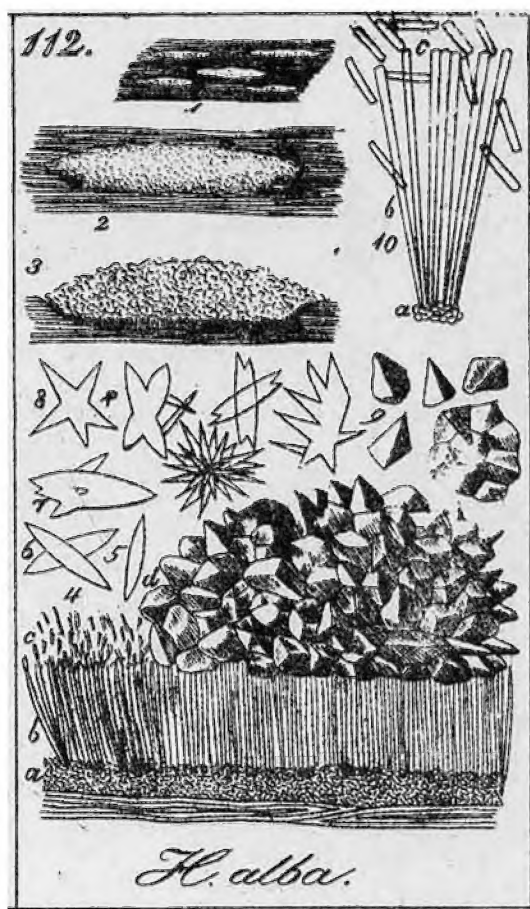


Figure 8. Illustration of *Hymenula alba* (Fr.) Corda (Corda 1838: 32, Tab. 14, fig. 112).

received copies of the *Scleromyceti Sueciae* from Fries, including fascicle nine (Shear 1949, Untereiner 2004), and it is probable that Schweinitz only ever received the first edition (Karakehian *et al.* 2024a). It is well documented that Schweinitz often discarded or re-wrote specimen labels attached to materials that he received from other mycologists (summarised in Karakehian *et al.* 2024a). In addition, later workers in Schweinitz fungarium such as Ezra Michener re-curated many specimens (Shear & Stevens 1917: 337), including this one, by gluing them to a new sheet of paper and copying the labels over (Shear *et al.* 1917). Michener sometimes did not transcribe all the data from the original labels (Shear & Stevens 1917: 338). We do not know if Michener failed to copy the *Scleromyceti Sueciae* species number 335 or if an original label was not with the specimen at the time he remounted the specimen. On face value, the specimen lacks labels or other, concrete information that would

connect it to Fries (ca. 1825). However, knowing that Schweinitz received issues of this exsiccata directly from Fries, including fascicle nine, as well as the history of the curation of the Schweinitz fungarium, we consider this specimen to be original material.

Another specimen of *S. alba* that was likely handled by Michener in the same way as the one at PH is in the Michener fungarium at BPI (BPI 1050201). Michener sampled portions of specimens from the Schweinitz fungarium as he conducted his curatorial work (Shear & Stevens 1917: 339). This specimen is from the Schweinitz fungarium, and it is possible that this is a duplicate of the specimen at PH and probably original material, but we did not study images of it.

There are two specimens in the Fries fungarium at UPS, F-543499 and F-117771 (Fig. 3e–f). We do not consider these to be original material because they appear to be from a gathering made later than the specimens issued as *Stictis alba* in fascicle nine of the *Scleromyceti Sueciae* (Fries ca. 1825). These specimens lack printed labels or notation indicating that they were part of this exsiccata and the number 335 written on the packets and labels seems to be a later addition. Moreover, the specimen labels, in Fries's script, give *Propolis alba* but this combination was not published until Fries (1849). In addition to this, Fries wrote the collection locality on the labels as Femsjö in Hägnen (Hägnen Nature Preserve in Hylte, Femsjö parish, Sweden): the collection locality of Femsjö was not noted in the sanctioning treatment of *Stictis alba* (Fries 1828) but it was given in Fries (1849). Finally, a note on the label of specimen UPS F-117771 (Fig. 3e) seems to indicate that Fries thought better specimens were number 335, in the *Scleromyceti Sueciae* (Fries ca. 1825) ("Scl. Suec. 335, ubi meliora specimina").

Our account of original material of *Stictis alba* issued in Fries (ca. 1825) is not exhaustive. Other institutions with holdings of specimens from the *Scleromyceti Sueciae* are given in Stafleu & Cowan (1976: 878) and Pfister (1985). We note that the American mycologist Moses Ashley Curtis succeeded Schweinitz in the study of North American fungi, and he sampled from the Schweinitz fungarium prior to Michener (Shear & Stevens 1917: 339). There are no specimens of *Stictis alba*, number 335 in the Curtis fungarium at FH according to Pfister (1975). We did not inquire at FH about a specimen in this collection, but it may be possible one is present,

and it was not recognised by Pfister as being from the *Scleromyceti Sueciae* (Fries ca. 1825) because of Schweinitz's practice of removing original labels.

Finally, we inquired at PC about Fries's *Scleromyceti Sueciae*, fascicle nine, and specimens of *Stictis alba*, number 335 (Fries ca. 1825). There is no copy of this exsiccata at this institution (Isabelle Bouchart-Dufay, pers. comm. 29 Sept 2023), but Stafleu & Cowan (1976: 878) note there are specimens at this institution, and Holm & Nannfeldt (1962) examined specimens (presumably loose) there. We do not know if they examined a specimen of *S. alba* at PC.

Concluding remarks on the specimens of *Stictis alba* that we located. Fries concluded that the material of *Sclerotium album* from Candolle that he studied and the material that he issued as *Stictis alba* in Fries (ca. 1825) were conspecific. We consider that all the specimens that we located contain the same snow-white, convex, and elongated crystalline bodies.

Lectotypification of *Stictis alba*. We chose to lectotypify *Stictis alba* with Candolle's specimen, G 00584953, because it is well preserved, ample, and is accompanied by several pieces of documentation that clearly connect it to Candolle and the preparation of the protologue of *Sclerotium album* (Candolle 1815). We suspect that Fries (1828) also examined this specimen. Finally, most of our detailed micromorphological studies were made from G 00584953, and we were able to provide thorough documentation of it in our written description and in Figure 2.

Notes on *Hymenula alba* (Fr.) Corda. Corda (1838) studied a specimen of *Stictis alba*, number 335, issued in Fries (ca. 1825) and transferred this name to *Hymenula* Fr. For ease of reference in the following discussion, our English translation of Corda's treatment is provided here (our editorials and corrections in brackets, figure citations edited for clarity), with his illustration reproduced in Figure 8 (Corda 1838: 32, Tab. 14, Fig. 112).

3. H. ALBA: Tab. XIV. Fig. 112. *Stictis alba* Fries *Scleromyc. Suec. no. 335. elongate submerged white; minute cylindrical spores.*

Dwells on the bare decaying wood of the deciduous trees in Sweden, in the company of Prof. Fries.

The species presents a curious excretion of crystals.

The conidiophores (fig. 4[a]) are sunken, small-celled,

the conidiogenous cell layer (fig. 4[b]) are formed from the conidiophores (fig. 10[a]) directly inserted cylindrical, stiff, light-colored [conidiogenous cells] (fig. 4[b] 10[b]), which also contain small cylindrical truncated spores (fig. 4[c] 10[c]). Above the fruit layer there is always a vaulted layer of a snow-white granular substance (fig. 3, fig. 4[d]), which, under high magnification, appears as a separation and accumulation of a large number of highly diverse, raphidoid (fig. 5), twinned (fig. 6) or multiple, larger, or smaller, or clustered crystals (fig. 7–9), which are only partially and with difficulty soluble in water.

Fig. 1. Natural size; fig. 2. A fructification, slightly magnified; fig. 3. One section, slightly magnified; fig. 4. A hand-section of the fruit-body greatly enlarged a. conidiophores, b. [conidiogenous cells], c. spores, d. crystal heaps; fig. 5–9. Different shaped crystals greatly enlarged; fig. 10. [conidiogenous cells] b. [conidiophores very much enlarged], c. [with spores].

Corda (1838) described and illustrated a sporodochium immersed in woody substratum with bacilliform conidia. The conidia are produced from a palisade-like layer of conidiogenous cells that arise from a layer of small, isodiametric cells. A thick layer of large, polymorphous crystals is massed on top of the layer of conidiogenous cells in the centre of the sporodochium. We note that there is the possibility that the spores Corda described as conidia could be spermatia.

From the standpoint of fungal biology, we question how the mitospores that Corda depicted, whether they be conidia or spermatia, could form and disperse from under a thick layer of crystalline material. Based on the illustration, it appears that the mitospores are released from the periphery of the sporodochium. It may also be possible that the sporodochia mature and sporulate from the centre outward, followed by a buildup of crystalline material. Because the crystals are insoluble in water, the mitospores could be dispersed by being washed out by rainwater.

Notes on the origin of the crystalline bodies. If we consider that the crystalline bodies are not sporomata or the senesced remains of them, we are unable to determine how the crystalline bodies originated. They might be a byproduct of fungal activity in the woody substratum, some kind of crystallised plant resin or gum, or the result of wood beetle activity, which might make sense considering the way some of the crystalline bodies appear to extend in tubes below the surface

of the substratum, as we observed in specimen ILLS 00122483. We are uncertain whether the occurrence of fungal hyphae within the crystalline bodies of specimen G 00584953 (Fig. 2g–h) is casual or if they are connected in some way.

Because specimen ILLS 00122483 was recently collected near Femsjö, Sweden, where Fries collected specimens that he issued in the *Scleromyceti Sueciae* (Fries & Fries 1955: 145), we attempted PCR and Sanger sequencing of a sample of the crystalline bodies on this specimen to see if we could amplify any fungal DNA, following the methods outlined in Karakehian *et al.* (2024b). We obtained an ITS sequence (ITS1–5.8S–ITS2) and a mtSSU sequence (GenBank numbers PP830817, and PP833617, respectively). We attempted to obtain an LSU sequence using primers LR0R (Rehner & Samuels 1995) and LR6 (Vilgalys & Hester 1990) but abandoned this after two failed attempts. We subjected these sequences to BLASTn searches (Altschul *et al.* 1990) with the result that these were similar to sequences of *Dactylospora*, *Fusichalara*, *Rhopalophora*, and *Sclerococcum* that are classified in Ascomycota, Eurotiomycetes, Sclerococcomycetidae, Sclerococcales, Sclerococcaceae (Réblová *et al.* 2017, Wijayawardene *et al.* 2022). The ITS sequence was similar to several voucher specimens identified as various *Dactylospora* species with 89–100% query cover (QC)/90–95% percent identity (PI). The ITS2 region of this sequence was 65%QC/99%PI to an environmental sequence (GenBank OR164708) identified as *Dactylospora* sp., which was obtained from a *Quercus robur* stump in Lithuania (Marčiulynas & Menkis 2024). In the tree view function of BLASTn, both the full ITS and ITS2 sequences were estimated as sister to the *Dactylospora* sp. environmental sequence. These clustered in a larger clade that included isolates obtained from the *Dactylospora* voucher specimens. The mtSSU sequence was most similar to an isolate identified as *Dothideomycetes* sp., GenBank KT263506 (Muggia *et al.* 2016), that was obtained from a lichen thallus, with 75%QC/94%PI. In the tree view function of BLASTn, our mtSSU sequence and KT263506 formed a lineage that was sister to a larger clade consisting of the various genera of Sclerococcaceae listed above. We stress again that we do not know whether the fungi from which we amplified these sequences are not casually associated with the crystalline bodies.

Disposition of *Propolis alba*. *Propolis alba* is not a species of *Propolis* and is not a heterotypic synonym of *P. farinosa*. Because we found no fungal reproductive structures, tissues, or ascospores in any of the specimens that we examined, we conclude that *Propolis alba* should not be placed in *Fungi*.

We refrained from placing *Propolis alba* in a different genus. We note that maintaining Corda's disposition of this entity as *Hymenula alba* would require forming a new combination, "*Hymenella alba*". This is because *Hymenula* Fr. (1825: 94) (nom. sanct. in Fries 1828: 37) is a nom. nov. for *Hymenella* Fr. (1822: 233), and although both genus names are sanctioned, *Hymenella* has priority following Art. F.3.5 in May *et al.* (2019).

Author contributions

JMK researched and wrote the manuscript. ANM edited the manuscript. JMK, <https://orcid.org/0000-0002-3571-3882>; ANM, <https://orcid.org/0000-0001-7300-0069>.

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Circumscribing *Propolis farinosa* (Fungi, Ascomycota) II: Typification of *Tremella saligna*, a synonym, based on a study of original material of Albertini & Schweinitz

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Introduction

This contribution is the second in a planned series of three publications dealing with names in *Stictis* subg. *Propolis* Fr. (Fries 1822: 198–199; 1828: 26–27) that have long been treated as synonyms of *Propolis farinosa* (Pers.) Fr. (Fries l.c., Minter 2003) though without recent, critical examination of type or original materials. *Propolis farinosa* is the type of *Propolis* (Fr.) Corda (Leotiomycetes, Marthamycetales). A brief description of *P. farinosa* with an illustration is given in the first contribution (Karakehian & Miller 2024). A definitive circumscription of *P. farinosa* is needed to elucidate the distribution, biology, and ecology of this fungus, as well as its evolutionary relationships with other species in the genus.

One name that has been considered a synonym of *Propolis farinosa* is *Stictis saligna* (Alb. & Schwein.) Pers. (Fries 1822: 198, Minter 2003). The basionym of *S. saligna* is *Tremella saligna* Alb. & Schwein., published in Johann Baptist von Albertini and Lewis David von Schweinitz's *Conspectus fungorum in Lusatae superioris* (Albertini & Schweinitz 1805, Hewitt *et al.* 2016). The name *T. saligna* has not been typified.

In this contribution, we outline our search for original material of *Tremella saligna* and provide a description of a specimen that we designate here as lectotype. Using our search for original material as a

Abstract

To circumscribe *Propolis farinosa* (Pers.) Fr., type of the taxonomically understudied genus *Propolis* (Fr.) Corda, we investigated the nomenclature and taxonomy of the synonym *Stictis saligna* (Alb. & Schwein.) Pers. The basionym of *S. saligna* is *Tremella saligna* Alb. & Schwein., described in Albertini and Schweinitz's *Conspectus fungorum in Lusatae superioris*. *Tremella saligna* has not been typified. We located original material of *T. saligna* in the form of published and unpublished illustrations and a specimen that is part of a set of specimens connected to the *Conspectus fungorum* in the National Herbarium of Victoria (MEL), Australia. Here, we lectotypify *T. saligna* and describe the type specimen. We conclude that *T. saligna* is appropriately placed as a synonym of *P. farinosa*.

Keywords: fungal nomenclature, fungarium, Johann Baptist von Albertini, lectotypification, Leotiomycetes, Lewis David von Schweinitz, mycological illustration, typification.

case study, we discuss the need to critically examine all original material and the importance of typifying using specimens versus illustrations when possible.

Methods

Literature research

We compared Persoon's handwriting on specimen labels in the Persoon fungarium in L to handwriting samples by Persoon in Burdet (1979). We compared Albertini's handwriting of the fungus name on the packet of specimen MEL 2332215 to a sample of his handwriting in Albertini (1801–1803).

We examined the published illustrations of *Tremella saligna* in four different copies of Albertini & Schweinitz (1805: Tab. IX, Fig. 7a-c) in the following collections: New York Botanical Garden, LuEsther T. Mertz Library (accessed through <https://www.biodiversitylibrary.org>); Farlow Reference Library, Harvard University (in-person); University of Illinois Urbana-Champaign Rare Books and Manuscripts (image); reproduction of Albertini & Schweinitz (1805) issued by Associazione Micologica Bresadola, Centro Studi Micologici. Vicenza, Italy, 1992 (location of the copy reproduced not specified).

We also examined an unsigned, undated manuscript that we attribute to Schweinitz based on the handwriting ([Schweinitz] n.d.). This is Schweinitz's list of new taxa described in Albertini & Schweinitz (1805), reviewed by Albertini. It provides notes on plant associates, localities, and specific dates of collections in addition to those published in Albertini & Schweinitz (1805).

Fungarium research

We conducted in-person and online searches (<https://mycoportal.org>, <https://www.gbif.org/>) for specimens labelled *Tremella saligna* or *Stictis saligna*. We paid special attention to fungaria where Schweinitz specimens are preserved: the Persoon fungarium at the Naturalis Biodiversity Center in Leiden, the Netherlands (L); the Schweinitz fungarium at the Academy of Natural Sciences of Drexel University in Philadelphia, Pennsylvania, USA (PH); the Curtis fungarium at the Farlow Herbarium of Harvard University in Cambridge, Massachusetts, USA (FH); the Ezra Michener fungus specimens held at the U.S. National Fungus Collections, USDA-ARS in Beltsville, Maryland, USA (BPI); and the

National Herbarium of Victoria at the Royal Botanic Gardens Victoria, Australia (MEL).

Additional specimens examined

Propolis angulosa. FINLAND: Ostrobothnia, Jakobstad; in dry branches of *Salix* sp.; 4 Nov 1862; Karsten (UPS F-632612, original material). GERMANY: as *Stictis saligna*, on bark and wood, probably of *Salix* sp. (L 0118547 [Persoon Herbarium, Herb. Lugd. Bat. No. 910.263-970]).

Morphology

Photomacrographs of UPS F-632612 and L 0118547 were made with a Canon EOS 6D digital SLR camera equipped with a Canon MP-E 65 mm lens with a ring light. The photomacrograph of MEL 2332215 was made using an Olympus DP74 camera attached to an SZX16 stereomicroscope and processed with the cellSens Standard 1.16 software.

Photomicrographs of UPS F-632612 and L 0118547 were made using transmitted light microscopy with an Olympus BX51 compound light microscope with 40×, 100×/1.30 oil immersion plan-achromatic objectives together with an Olympus XC50 5.0-megapixel digital camera and Olympus cellSens Standard 1.14 image processing software. Preparations of these specimens were mounted in 10% KOH followed by a tap water rinse and the addition of aqueous phloxine. Preparations of MEL 2332215 were mounted in 10% KOH and photographed with an Olympus DP73 camera attached to a BX51 microscope and processed with the cellSens Standard 1.16 software.

Images were processed in Adobe Photoshop version 25.2. Figures were created in Adobe Illustrator version 28.1. To save space in a figure or improve readability, we manipulated certain images using Photoshop. To save space, the image in Figure 1b is a photomontage. For improved readability, the illustrations surrounding that of *Tremella saligna* were erased in Fig. 2a.

Measurements in the description of MEL 2332215 in the results section are given as minimum/maximum ranges with the number of measurements given as "n=".

Results

Disposition of *Tremella saligna* as a synonym of *Propolis farinosa*

Propolis farinosa (Pers.) Fr. *Summa veg. Scand.*, Sectio Post.: 372 (1849) [for typification and other information see Karakehian & Miller (2024)].

Synonym: *Tremella saligna* Alb. & Schwein., *Consp. fung. lusat.*: 303 (1805).

≡ *Stictis saligna* (Alb. & Schwein.) Pers. *Mycol. eur.* 1: 337 (1822).

Typification: Lectotype designated here: “*Tremella saligna* Mis. Albert.,” MEL 2332215! (MB 10020458).

Description of lectotype specimen MEL 2332215.

Apothecia 0.5–1.7 × 0.3–0.6 mm (n=9); erumpent through the end-grain of wood substratum; inner surface of marginal flaps black; disc with farinaceous layer (pseudoepithecium) white–cream, without this layer semi-opaque, reddish; **paraphyses** 1–2 µm diam, filamentous, apices somewhat contorted, occasionally branching or with short projections, tips immersed in a pseudoepithecium; **asci** 131–175 × 14–17 µm (n=7), cylindric-clavate, with undifferentiated, dome-shaped, inamyloid apices, ascospores biserial at the apex, becoming uniserial toward the foot; **ascospores** 22.4–

26.6 × 6–7.9 µm (n=16), cylindrical, straight or slightly curved, thin-walled, smooth, hyaline, poles obtuse, with two large guttules that flank the midpoint 4.5–6.6 µm diam. (n=24) (Fig. 1a–c).

Nomenclatural history. We note that the treatment by Persoon (1822) of *Stictis saligna* is adapted from Albertini & Schweinitz’s protologue. Fries (1822: 198) synonymised *Stictis saligna* and *Hysterium fagineum* Schrad. under one of his four unnamed, unranked infraspecies of *Stictis* (*Propolis*) *versicolor*: “a. disco lacteo, [...]”. Therefore, the names *S. saligna* and *H. fagineum* are not sanctioned. We found no previous typifications of *Tremella saligna* by searching under this name and *S. saligna* in fungal name databases (<http://indexfungorum.org>, <https://mycobank.org>), Sherwood (1977: 241–242), and general internet queries.

The search for original material of *Tremella saligna*.

We studied the protologue of *T. saligna* (Albertini & Schweinitz 1805: XV, XXII, 303–304, Tab. IX, Fig. 7a–c) to locate original material with which to lectotypify this name. The protologue included an illustration that is original material (Art. 9.4b in Turland *et al.* (2018), hereafter, *ICN*). This is a hand-coloured etching made by Schweinitz (Hewitt *et al.* 2016, Karakehian *et al.*

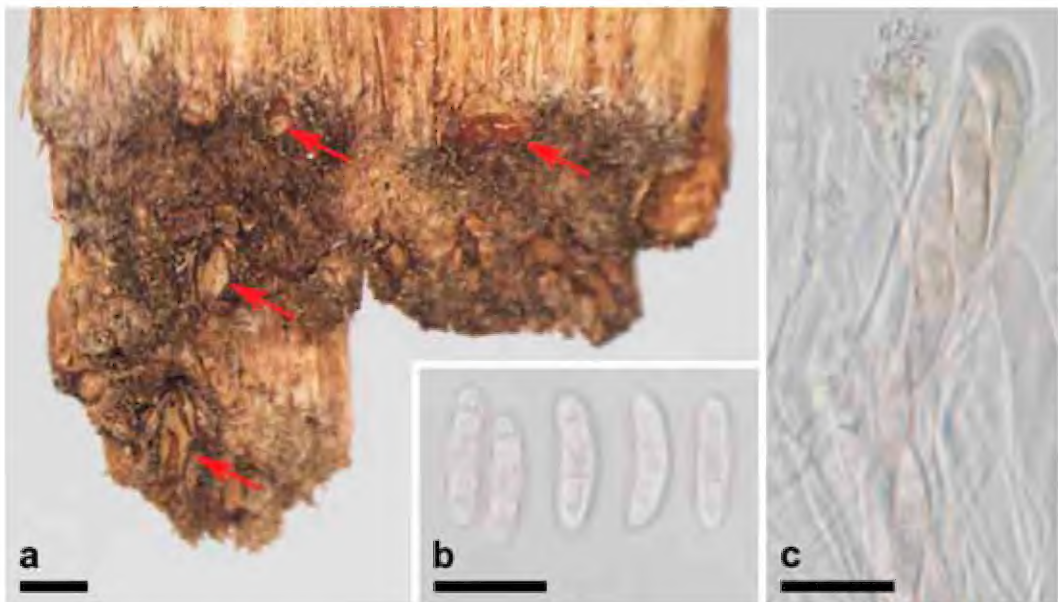


Figure 1. Morphology of MEL 2332215, lectotype of *Tremella saligna*. **a** Face-view of end grain of wood showing dried apothecia (marked by red arrows); the apothecia on the left have tan-coloured, farinaceous discs (pseudoepithecium), while this is lost in the apothecium on the right. **b** Ascospores, mounted in 10% KOH. **c** Immature ascus (far right) and mature ascus (center), with filamentous paraphyses; note the remains of the crystalline material that comprises the pseudoepithecium at the tips of the paraphyses to the left of the mature ascus; mounted in 10% KOH. **Scale bars:** **a** 1 mm; **b**, **c** 20 µm.

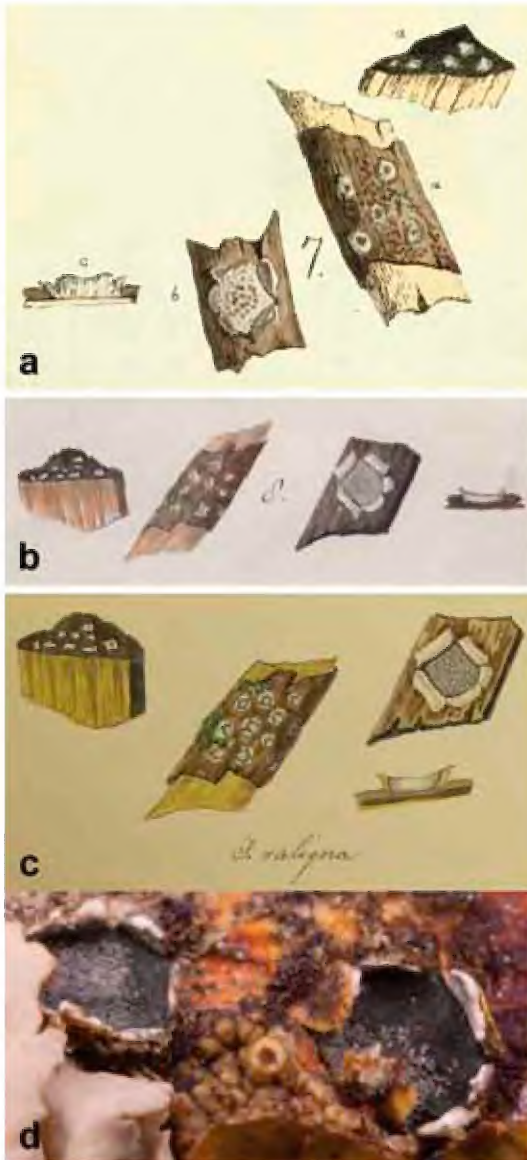


Figure 2. Illustrations of *Tremella saligna* by Schweinitz, and apothecia of *Propolis angulosa* from original material.

- a** hand-coloured etching published in Albertini & Schweinitz (1805: Tab. IX, Fig. 7a–c [caption: XXII]).
- b** unpublished watercolour painting in (Schweinitz 1803: pl. 235 fig. 8).
- c** unpublished, hand-painted copy of the illustration shown in b (Schweinitz ca. 1818–1826: pl. 212).
- d** hydrated apothecia of *Propolis angulosa* (original material, UPS F-632612), showing erumpent habit (through bark), dark-grey farinaceous discs (pseudoepithecium) dusted with a thin white layer, and stark-white inner surfaces of the marginal flaps.

2018), which comprises four elements that depict the macromorphology of *T. saligna* (Fig. 2a).

The hand-coloured etching published in Albertini & Schweinitz (1805) corresponds to an unpublished watercolour painting by Schweinitz (1803: pl. 235 fig. 8) (Fig. 2b) that is also original material. An unpublished, hand-painted copy of this was made by Schweinitz after publication of Albertini & Schweinitz (1805) and is not original material (Schweinitz ca. 1818–1826: pl. 212) (Fig. 2c). The watercolour painting was created in conjunction with the development of Albertini & Schweinitz (1805): Schweinitz assiduously painted the specimens that he and Albertini collected. This was especially important to document ephemeral characters of fresh, fleshy fungi such as shape, coloration, and size, all of which would begin to change soon after the specimen was collected, and dramatically so after being dried for storage in their fungarium (Albertini & Schweinitz 1805: XI–XII, Hewitt *et al.* 2016: 57). However, Schweinitz also illustrated fungi that were tough, hard, carbonised, or that generally changed little upon drying, like *T. saligna*. Ultimately, Schweinitz bound these illustrations into a set of five volumes. These contain illustrations for nearly every species in Albertini & Schweinitz (1805). This is notable because not all the new species in Albertini & Schweinitz (1805) are illustrated, but nearly all of them have an illustration in the unpublished, five-volume set. Several of their new species, such as *T. saligna*, are illustrated in both (Karakehian *et al.* 2018). Schweinitz's volumes of unpublished watercolour paintings are original material because Albertini and Schweinitz (1805) explicitly state in the introduction that they [Schweinitz] referred to these volumes as the etchings for publication were prepared (Art. 9.4a of *ICN*) (Albertini & Schweinitz 1805: XI–XII, Hewitt *et al.* 2016: 57). The volumes are now housed in the archives of various institutions and are available online through Biodiversity Heritage Library (<https://www.biodiversitylibrary.org>) (Hewitt *et al.* 2016, Karakehian *et al.* 2018). A list of the volumes and their contents, as well as links to each volume are published in Karakehian *et al.* (2018). A forthcoming publication will provide an index to taxa in Albertini & Schweinitz (1805) that is cross-referenced to Schweinitz's published and unpublished illustrations. A partial index to 78 names of fungi introduced by Albertini & Schweinitz (1805) is given in Karakehian *et al.* (2024, Table 1).

A comparison of the published and unpublished illustrations of *T. saligna* (Fig. 2a, b) demonstrates that the published illustration was clearly based on the unpublished painting, but it is not an exact copy. The overall elements of the two illustrations are highly similar, particularly the inclusion of four pieces of substrate, the shape and aspect of which can be matched between the two illustrations, except that the order is reversed due to the printing process. However, there are slight differences between the two illustrations in the number and distribution of apothecia on the two elements depicting bark on a branch and the end-grain of a piece of wood (elements “a” in Fig. 2a). Furthermore, there is a subtle yet important difference that could have taxonomic implications. In the published illustration (Fig. 2a, apothecium “b”), in each of the four different copies of Albertini & Schweinitz (1805) that we examined, the discs are white with some grey colouration in the centre, and with dark-grey inner surfaces of the flaps. This agrees with *Propolis farinosa* (cf Karakehian & Miller 2024: Fig. 1b). In the unpublished illustration (Fig. 2b, apothecium to the right of the number 8) the disc is medium grey with white inner surfaces of the flaps, which is more consistent with *P. angulosa* P. Karst. (cf Fig. 2d, from UPS F-632612, original material of *P. angulosa*). Therefore, to reduce ambiguity in the definition of *T. saligna* and to maintain its previously accepted disposition as a synonym of *P. farinosa*, we remove the unpublished watercolour illustration from further consideration as a potential lectotype.

Although no specimens or gatherings were cited in the protologue of *Tremella saligna*, information given in the text of the protologue could help to identify original material in the form of specimens. This included collection localities in or near Niesky, Germany (Cane and Schinderleibchen), plant associate (*Salix alba*), substratum (bark and decorticated wood), and months when the fungus was observed (October and November). We consulted the entry for *T. saligna* in [Schweinitz] (n.d.) and obtained further information in the form of a specific day (31 Oct) and another locality (Jänkendorf).

With this information we conducted in-person and online searches for specimens labelled *Tremella saligna* or *Stictis saligna*. We did not locate specimens at PH, FH, or BPI. We located a specimen labelled “Stictis Saligna.

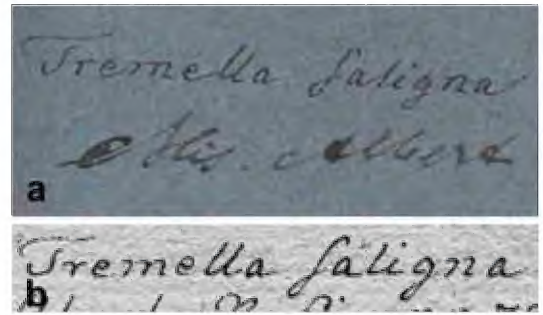


Figure 3. **a** Label on specimen packet of MEL 2332215, lectotype of *Tremella saligna*, with “Tremella Saligna” written by Albertini and “Mis. Albert” [misit Albertini: sent by Albertini] written by an unknown scribe. **b** Handwriting sample from page of a manuscript written by Albertini (1801–1803) for comparison to the handwriting of the fungus name in a (cf Karakehian *et al.* 2024).

Tremella [saligna] Albertini et Schweinitz. Germania.” in the Persoon fungarium at L, L0118547, that is not original material. We provide further analysis of this specimen in the Discussion section, below. The only other specimen that we located is MEL 2332215 (<http://plants.jstor.org/stable/10.5555/al.ap.specimen.mel2332215>), which is original material of *Tremella saligna*. It is part of a set of 77 specimens of new names published in Albertini & Schweinitz (1805) that have recently come to light at MEL. These are presumed to have come to MEL in the late 19th century as part of the herbarium of Otto Wilhelm Sonder (Short 1990). Karakehian *et al.* (2024) demonstrated that these specimens are original material of the 77 new names.

The name *Tremella saligna* was written on the packet of MEL 2332215 by Albertini, judging by a comparison of this (Fig. 3a) and a sample of the same name from an archived manuscript known to have been written by him (Albertini 1801–1803) in conjunction with the preparation of Albertini & Schweinitz (1805) (Fig. 3b). The material consists of a small piece of decorticated wood bearing several apothecia on the end-grain (Fig. 1a). A comparison of the position of these apothecia and the shape of the piece of wood against Schweinitz’s published and unpublished illustrations (Fig. 2a uppermost right element “a”; Fig. 2b leftmost element) indicated that the two are not identical, although they share a general similarity in that the apothecia are on the end grain. Although the specimen is not ample, it

is well-preserved and adequate to conduct studies of macro- and micromorphological characters.

Lectotypification of *Tremella saligna*. In lectotype designation, any extant isotypes must be selected from over illustrations. If there are no isotypes, then syntypes or isosyntypes must be selected from. Finally, if there are no syntypes or isosyntypes, then paratypes must be selected from. In the absence of any of these specimens “the lectotype *must* be chosen from among the uncited specimens *and* cited and uncited illustrations that comprise the remaining original material, if such exist [our italics (Art. 9.12 of *ICN*)]”. The remaining original material that we located included three elements: specimen MEL 2332215 and the published and unpublished illustrations (Art. 9.4(a, b) of *ICN*). We excluded the unpublished illustration from consideration as a lectotype because it was ambiguous which species was being depicted (discussed on p. 67). We chose specimen MEL 2332215 over the published illustration as lectotype of *Tremella saligna*. This specimen agrees with the protologue of *Tremella saligna*. It is preferable as a lectotype because, unlike the illustration, it may be subjected to morphological and other analyses.

Disposition of *Tremella saligna* as a synonym of *Propolis farinosa*. The morphological features of the lectotype specimen MEL 2332215 agree with descriptions of *Propolis farinosa* given in Rehm (1888, as *P. faginea*), Saccardo (1889, as *P. faginea*), Breitenbach & Kränzlin (1984, as *P. versicolor*), Thompson (2013), Chlebická (2014), and Minter (2019), as well as our observations of the proposed conserved type of *P. farinosa* (Karakehian et al. 2023). Based on the similarities in macro- and micromorphology of this lectotype specimen of *T. saligna* and our proposed conserved type of *P. farinosa*, we consider the former name to be a synonym of the latter.

Discussion

The specimen labelled *Stictis saligna* in the Persoon fungarium at L (L 0118547) is not *Propolis farinosa*. Our examination of this material led us to consider whether the fungus depicted in Schweinitz’s unpublished watercolour illustration of *Tremella saligna* was in fact *Propolis angulosa*. The following discussion provides

a case study in the need for critical examination of all original material when designating a lectotype.

The handwriting on the two labels of specimen L 0118547 is mostly Persoon’s, with the notation “Hb. Pers.” written by an unknown scribe (Fig. 4a, b). Other than the locality of Germany, there is no further collection information or notes that would serve to connect it to

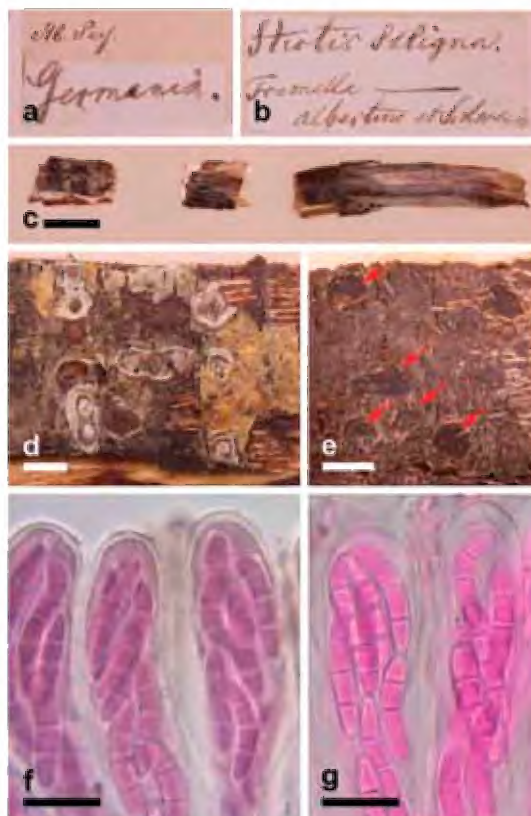


Figure 4. Morphology of a specimen of *Propolis angulosa* in the Persoon fungarium at L, labelled as *Stictis saligna*, and asci of *P. angulosa* from original material. **a–f** *Propolis angulosa*, L 0118547. **a** Specimen label with “Germania.” [Germany] written by Persoon and the notation “Hb. Pers.” written by an unknown scribe. **b** Specimen label with “*Stictis Saligna*. *Tremella* [saligna] *Albertini et Schwein*” written by Persoon. **c** Specimen consisting of three pieces of wood glued to paper. **d, e** Detail views from the leftmost and rightmost elements of specimen shown in c with red arrows pointing to damaged apothecia that have lost their marginal flaps and pseudoepithecium. **f** Asci and ascospores. **g** Asci and ascospores of original material of *P. angulosa*, UPS F-632612, for comparison to f.

Reagents used: **f, g** 10% KOH pretreatment followed by water rinse, then dilute aqueous phloxine.

Scale bars: **c** 1 cm; **d, e** 1 mm; **f, g** 10 µm.

the information given in the protologue. We also do not know how the specimen came into Persoon's collection. Therefore, there is no way to determine whether the specimen is original material. The macromorphology of the specimen is obliterated; it had been exposed to elements or handled in such a way that the marginal flaps and farinaceous pseudopithecium were missing (Fig. 4c–e). However, the hymenia were intact, and we studied asci and ascospores (Fig. 4f). The specimen is *P. angulosa* (cf Fig. 4g, from UPS F-632612, original material of *P. angulosa*). We examined several apothecia sampled from the three different pieces of wood in specimen L 0118547 and all of them were *P. angulosa*, except for one that was *P. farinosa*. The *P. farinosa* apothecium was near to apothecia of *P. angulosa*. Given that specimen L 0118547 contains apothecia of both *Propolis angulosa* and *P. farinosa*, and that *Tremella saligna* and *P. angulosa* were both described from *Salix*, it is possible that Albertini and Schweinitz had, at one time or another, gathered both species and did not recognise them as distinct.

The phenomenon of mixed collections has been observed in other *Propolis* species (Tulasne & Tulasne 1931 [vol. 1]: 226–227 [additional note IX], [vol. 3]: 116–119, Tab. 16, Fig. 4, 7, 8). It has also been observed in other inoperculate discomycetes such as *Orbilina* (Baral *et al.* (2020: 146–147). Mitchell *et al.* (2021: 25) observed it among certain taxa of Sareomycetes and provided a detailed analysis and recommendations for working with mixed collections. These included the need for caution when sampling apothecia for genetic studies or other experiments because harvesting more than one apothecium from a collection without first verifying their micromorphology might lead to a mixture of different species, thus confounding the data.

There are some discrepancies between the features of the MEL specimen of *T. saligna* and the original and published illustrations of this species, and between these two illustrations themselves. Discrepancies are also evident in comparisons between the original watercolours and the published plates for several other species published in Albertini & Schweinitz (1805) (Karakehian *et al.* 2018). There are two broad scenarios that may account for such discrepancies. Focusing on the case of *T. saligna*, firstly, it is conceivable that the specimen is indeed the basis for one of the elements

in the illustration (the piece of substratum with apothecia on the end grain), with the differences due to “artistic licence”, i.e. not intentional from a taxonomic perspective. Due to the high overall similarity between the illustrations, it is conceivable that differences between them are also due to “artistic licence”. Alternatively, a different specimen was involved in making the watercolour illustration, and the differences between the illustrations were also due to different specimens being utilised. Focusing on the difference between the original and published illustrations (which has taxonomic significance), perhaps Albertini & Schweinitz used additional knowledge from familiarity with both *P. farinosa* and *P. angulosa* to intentionally alter the colour scheme to more closely reflect the character of the former species in the published illustration. Deciding on which of these scenarios applied requires a more comprehensive analysis of specimens and corresponding original and published illustrations to shed light on the practice of Albertini and Schweinitz in preparation of published illustrations. In the absence of a definitive explanation for the discrepancies the selection of the specimen as lectotype removes any doubt about the interpretation of *T. saligna*.

Following Art. 9.12 of the *ICN*, because there are no isotypes, syntypes, isosyntypes, or paratypes, we could choose a lectotype from any of the three elements of original material that we found: specimen MEL 2332215, and the published and unpublished illustrations. If we had not excluded the unpublished illustration from consideration as lectotype, and instead chose it as lectotype, *Tremella saligna* would be interpreted as having white inner surfaces of the marginal flaps and a medium- or dark-grey disc. Such an interpretation is consistent with *Propolis angulosa*. To avoid doubt, it would then be advisable to designate a specimen as epitype (Art. 9.9 of *ICN*, Lendemer 2020) to resolve the correct application of *T. saligna* one way or another.

This hypothetical situation serves to emphasise the importance of specimens over illustrations in fixing species definitions. Illustrations often have a higher degree of ambiguity in interpretation than do specimens. Furthermore, a specimen that is ample and well cared for in an institutional fungarium provides a resource that future mycologists may turn to as a reference for questions yet to be formulated.

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The authors declare no conflicts of interest.

Author contributions

JMK researched and wrote the manuscript. ANM edited the manuscript. CT conducted morphological analysis of specimen MEL 2332215 and edited the manuscript. TWM provided history and provenance of the set of Albertini and Schweinitz specimens at MEL, input on nomenclature, and edited the manuscript. — JMK, <https://orcid.org/0000-0002-3571-3882>; ANM, <https://orcid.org/0000-0001-7300-0069>; CT, <https://orcid.org/0000-0002-8510-1761>; TWM, <https://orcid.org/0000-0003-2214-4972>.

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Two additions to the lichen genus *Coenogonium* in Tasmania, with a revised key

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Abstract

Two species of the lichen genus *Coenogonium* are added to the Tasmanian census: *C. dilucidum* (Kremp.) Kalb & Lücking, a widespread, pantropical, foliicolous species; and *C. flavoinpersum* Kantvilas *sp. nov.*, characterised by apothecia 0.5–1.2 mm wide, a subhymenium and hypothecium densely inspersed with yellow oil droplets, and narrowly ellipsoid ascospores, 8.5–12 × 2.5–4 µm. The placement of the new species in *Coenogonium* is discussed. A key to the nine species of the genus recorded for Tasmania is presented.

Keywords: Australia, Coenogoniaceae, exciple, *Gyalecta*, lichenised fungi, *Melaleuca* woodland, new species, taxonomy

Introduction

Coenogonium is a large genus of about 90 species, represented in most regions of the world but most speciose by far in the tropics (Rivas Plata *et al.* 2006; Kalb *et al.* 2016; Lücking *et al.* 2017; Lima *et al.* 2023). As currently circumscribed, it includes both filamentous species and crustose species that were traditionally placed in the genus *Dimerella* (Lücking & Kalb 2000). Species of *Coenogonium* occur on a wide range of substrata, including bark, wood, bryophytes and rocks; a significant number, particularly in tropical latitudes, is exclusively foliicolous. In general, the orange to yellowish, biatorine apothecia with a persistent margin, in combination with the *Gyalecta*-type asci and *Trentepohlia* photobiont, make *Coenogonium* easily recognisable at genus rank. However, the identification and delimitation of species can be challenging and is based on often-subtle differences in apothecial size and colour, hymenium height, ascospore size and arrangement within the ascus, and conidial size and morphology.

McCarthy (2023) lists 34 species for Australia, with the greatest diversity occurring in Queensland. In Tasmania, the genus was revised by Kantvilas *et al.* (2018) who recognised seven species. These included two that are endemic to the island (*C. atherospermatis* Kantvilas *et al.* and *C. urceolatum* Kantvilas *et al.*), the Australasian species *C. australiense* Kantvilas & Lücking, *C. implexum* Nyl. and *C. lutescens* (Vězda & Malcom) Malcolm, and two cosmopolitan/pan-temperate species (*C. luteum* (Dicks.) Kalb & Lücking and *C. pineti* (Schrader ex Ach.) Lücking & Lumbsch). In that work, it was acknowledged that further taxonomic questions remained to be addressed and that it was likely that additional species may well be present. Further studies of then-unresolved herbarium collections, and additional field work, especially in some previously poorly-studied, coastal swampy woodlands in Tasmania's north, have led to the recognition of two further taxa. These are described and discussed here.

Material and Methods

The study is based mainly on the collections of the first author held in the Tasmanian Herbarium (HO) and comparison with selected reference exsiccatae from other herbaria as cited in text. Observations and measurements are based on hand-cut sections of the thallus and apothecia mounted in water and Lugols iodine after pretreatment with 10% KOH (indicated as KI in the text). Exciple structure was studied by staining apothecial sections in lactophenol cotton blue, lactophenol trypan blue and vinegar-ink (Powell 2018), all without pretreatment in 10% KOH. Measurements of asci, ascospores and conidia are based exclusively on sections mounted in water. Ascospore measurements are presented in the format: smallest measurement–mean–largest measurement, with *n* signifying the number of observations and outlying values given in parentheses.

Taxonomy

Coenogonium flavoinspersum Kantvilas *sp. nov.*

MycoBank no. MB 854418

Similar to *Coenogonium luteum* (Dicks.) Kalb & Lücking, with apothecia 0.5–1.2 mm wide and narrowly ellipsoid ascospores, 8.5–12 x 2.5–4 µm, but differing by having the subhymenium and hypothecium densely inspersed with yellow oil droplets.

Type: Australia: Tasmania, Stony Head Training Area, Quarry Road, c. 830 m E of Airfield Quarry, 41°02'26"S 146°59'40"E, 50 m, on *Melaleuca ericifolia* in a small, degraded patch of swamp, 19 March 2021, G. Kantvilas 95/21 (holo - HO; iso - B).

Thallus crustose, corticolous, dull pale grey-green to dingy green, usually smooth and effuse, forming irregular, diffuse, often rather discontinuous patches 30–100(–160) mm thick amongst other lichens; photobiont cells subglobose to ellipsoid, 8–20 x 7–10 µm, usually forming short chains. **Apothecia** sessile, 0.5–1.2 mm wide, scattered; disc dull orange-pink to pale orange, sometimes wholly or partially discoloured dark brown, persistently plane; proper exciple persistent, pale cream (paler than the disc), sometimes with a faint orange-pink tinge, smooth and entire, in section annular, hyaline, 70–110 µm thick at the sides, 70–130 µm thick at the base, composed of branched and anastomosed hyphae with narrow

lumina that expand and become parenchymatous towards the outermost edge. **Hypothecium** 50–120 µm thick, hyaline, inspersed in the upper part with yellow oil droplets 2–6 µm wide, the colour fading with herbarium storage. **Hymenium** 50–80 µm thick, hyaline in the upper part, yellow below due to inspersation with yellow oil droplets as in the hypothecium, I+ fleeting greenish blue, soon yellow-brown, KI+ pale blue; paraphyses straight, simple, 1–1.5 µm thick, with the apices swollen, sometimes moniliform, 2.5–3.5 µm thick; asci 40–55 x 5–8 µm. **Ascospores** mostly irregularly biserial in the ascus, occasionally uniserial and obliquely arranged, narrowly ellipsoid, (8.5–)9–10.4–12 x 2.5–3.0–4 µm; length to breadth ratio 2.8–3.5–4.2 (*n* = 80). **Pycnidia** very rare, wartlike, 0.1–0.2 mm wide; conidia ellipsoid, simple, 3.5–5 x 1.5–2 µm. Figs 1–2, 3C.

Etymology: The specific epithet *flavoinspersum* refers to the inspersation of subhymenial tissues with large, yellow oil droplets.

Remarks: With its relatively narrow, small ascospores, the new species is most similar to the widespread *C. luteum*. It differs starkly by having a subhymenium and hypothecium densely inspersed with large, yellow oil droplets which convey a strong yellowish colour to these tissues when viewed in thin cross-section at high-power magnification (Fig. 2). A difficulty arises, however, in that the yellow colour fades in herbarium storage (usually after c. 3 years), even as the droplets themselves remain. Thus, the identification of older herbarium specimens requires considerable care, and most such collections of the new species were initially subsumed



Figure 1. *Coenogonium flavoinspersum* habit (type collection). Scale = 2 mm. Photo: J. Jarman.

within the broad variation of *C. luteum* or, in one case, *C. australiense*. Similar instances where taxonomically significant oil bodies can only be observed in fresh collections occur in some liverwort groups (Stewart 1978). Oil droplets are seen in some specimens of *C. luteum*, but these are smaller ($<3\ \mu\text{m}$ wide), fewer and hyaline from the outset. A further anatomical difference displayed by the new species lies in the paraphyses, which have barely capitate apices, whereas these are usually markedly capitate in other species of *Coenogonium*.

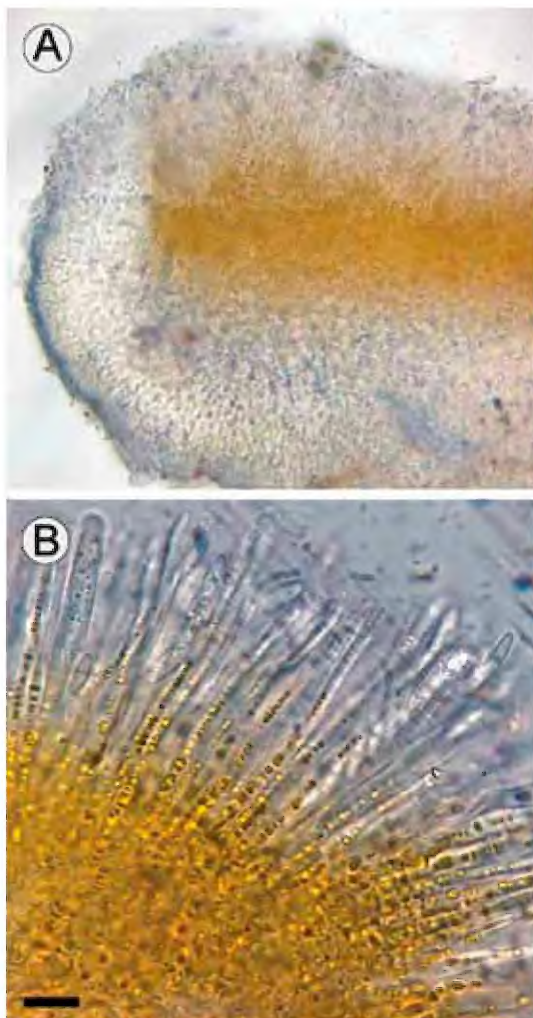


Figure 2. Anatomy of the apothecia of *Coenogonium flavoinspersum*. **A:** transverse section (in lactophenol cotton blue); note the yellow subhymenial tissues. **B:** detail of the hymenium, showing large, yellow oil droplets in the hypothecium and the lower part of the hymenium. Scale = $10\ \mu\text{m}$. Photo: M. Baker.

The distinctiveness of the new species only came to be appreciated as a result of several field excursions to typical *C. flavoinspersum* habitat, where microscope examination of fresh collections immediately drew attention to the significance of the yellow oil droplets. Other differences between *C. flavoinspersum* and *C. luteum* are that the apothecia of the former are at the smaller end of the range displayed by *C. luteum* and do not exceed $1.2\ \text{mm}$ diameter, whereas those of *C. luteum* are frequently as wide as $2.5\ \text{mm}$. In addition, the apothecial margin of *C. flavoinspersum* is consistently markedly paler than the disc, whereas in *C. luteum*, the margin is often $\pm$ concolorous with the disc or only a little paler. Furthermore, *C. luteum* occurs on a relatively wide range of substrata, including moist or dry bark, wood, rotting plant material, fibrous fern trunks and even, rarely, rocks; it also overgrows epiphytic bryophytes. Its thallus ranges from smooth to verruculose and typically reflects the texture of the substratum. In contrast, *C. flavoinspersum* has only been recorded growing directly on bark, and only with an effuse, film-like thallus. Separation of *C. flavoinspersum* from *C. australiense* is more straightforward, with the latter having longer and wider ascospores: $10\text{--}14 \times 3\text{--}4\text{--}(4.5)\ \mu\text{m}$ (Kantvilas *et al.* 2018).

It is the habitat ecology of the two species that is completely different. *Coenogonium luteum* is mostly a species of rainforest and wet eucalypt forest where it forms extensive thalli on moist, often mossy tree trunks and especially on the fibrous trunks of tree ferns (*Dicksonia antarctica*). In Australasia, it is known from Tasmania, Victoria, New South Wales, Queensland (McCarthy 2023) and New Zealand (Galloway 2007). It is essentially a cosmopolitan species found in wet forest habitats (Cannon *et al.* 2021; McCune 2017). In contrast, *C. flavoinspersum* is almost exclusively found in lowland, coastal vegetation. Its Tasmanian stronghold is in *Melaleuca ericifolia*-dominated swamps where it occurs on the papery bark of *Melaleuca* itself, or on subdominant trees in these swamps, such as *Bursaria spinosa* and *Acacia melanoxylon*. In this woodland type, it is associated with a small number of other lichens with a similarly distinct habitat ecology, including *Arthonia nigrorufa* Müll.Arg., *Bacidia septosior* (Nyl.) Zahlbr., *Bactrospora metabola* (Nyl.) Egea & Torrente, *B. paludicola* Kantvilas, *Caloplaca pulcherrima* (Müll.Arg.) S.Y.Kondr.

& Kärnefelt, *Enterographa micrographa* (Nyl.) Redinger, *Haematomma sorediatum* R.W.Rogers, *Leptogium coralloideum* (Meyen & Flot.) Vain., *Pseudocyphellaria aurata* (Ach.) Vain. and two, as yet undescribed taxa of *Arthothelium* and *Enterographa* respectively, as well as with the ecologically more widespread species, *Arthothelium ampliatus* (C.Knight & Mitt.) Müll.Arg., *Cliostomum griffithi* (Sm.) Coppins, *Ochrolechia africana* Vain. and *Pannaria elixii* P.M.Jørg. & D.J.Galloway. Two specimens from locally wet scrub communities at higher elevations in the drier hinterland of Tasmania's east coast were also identified as *C. flavoinspersum* on the basis of the presence of dense, large oil droplets in the subhymenium, although their habitat and localities are rather distant from core *C. flavoinspersum* habitat. A specimen from Kangaroo Island, South Australia, remains enigmatic. Collected from relict, coastal, *Callitris*-dominated woodland, it was initially ascribed to *C. australiense* by Kantvilas (2019). However, the small ascospores, 10–13 x 2.5–3 µm, and moderately inspersed hypothecium and subhymenium suggest it is better accommodated, albeit with some reservation, under *C. flavoinspersum*.

Generic considerations

The inspersation of subhymenial tissues with yellow oil droplets in the new species is so unusual for *Coenogonium* that an alternative classification in *Gyalecta* was considered (at the suggestion of an anonymous referee). After traditionally having been included in the same family (Gyalectaceae), *Coenogonium* was removed to its own family, Coenogoniaceae, on the basis of DNA sequence data (Kauff & Lutzoni 2002; Lücking *et al.* 2019) and anatomical and ontogenetic observations (Kauff & Büdel 2005). *Gyalecta* itself has also been subject to taxonomic reappraisal that has seen it subsume *Belonia* and *Pachyphiale* (Baloch *et al.* 2013) and *Cryptolechia* (Lücking *et al.* 2019).

Anatomical differences in the apothecia of *Coenogonium* and *Gyalecta* are discussed by Kauff & Büdel (2005). Following detailed examination of apothecial structure in the present study, the most critical of these is the cupulate exciple composed of branched and anastomosed hyphae with relatively thin lumina in *Gyalecta*, versus an annular exciple composed of hyphae with relatively wide lumina that

become parenchymatous in *Coenogonium*. The annular structure is easily missed in broadly flattened apothecia and requires sectioning through the apothecium centre, but a good transverse section demonstrates that it is the subhymenial tissues that connect the apothecium to the substratum and thallus, and not the exciple. This feature is evident in the new species described here and supports its inclusion in *Coenogonium*. The form of excipular hyphae in *Coenogonium* is more variable (Fig. 3). In all species examined, these are branched and radiate towards the outer edge where the lumen broadens to form a parenchyma. However, the hyphae within the exciple vary, and whereas in some species (or specimens) studied, the lumen is relatively wide throughout, in *C. flavoinspersum* it is very narrow and widens to a parenchyma only at the very outer edge. To what extent this is an artefact of apothecium age, and not species-specific could not be established. However, the anatomy of *C. flavoinspersum* is also strongly supportive of its inclusion in *Coenogonium* rather than *Gyalecta* (see Fig. 3).

Further supporting the inclusion of this taxon in *Coenogonium* is the morphology of the ascospores. These are identical to those of other species of the genus: narrowly ellipsoid and 1-septate, whereas in *Gyalecta*, the ascospores are highly variable and can be multiseptate or muriform.

Kauff & Büdel (2005) also observed that the hymenial gel in *Gyalecta* is KI-, whereas that of *Coenogonium* is KI+ pale blue. This was not confirmed in the present study, where a KI+ pale blue hymenial reaction was observed in *Gyalecta sens. str.* [as exemplified by the type, *G. geoica* (Wahlbg.) Ach.] and species of *Gyalecta* that had previously been included in *Belonia*. In all *Coenogonium* species studied, the hymenium is KI+ pale blue.

Specimens examined: TASMANIA: Meadstone Falls, 41°45'S 148°05'E, 420 m, 1.viii.1999, *G. Kantvilas* 334/99 (HO); M-Road, c. 1 km N of Breasted Sugarloaf, 42°11'42"S 147°53'12"E, 630 m, 26.vi.2018, *G. Kantvilas* 87/18 (HO); end of Bolduans Road, 40°47'S 145°02'E, 1 m, 30.xi.2011, *G. Kantvilas* 475/11 (HO); Stony Point, 40°45'S 144°59'E, 2 m, 25.x.2016, *G. Kantvilas* 272/16 (HO); Cape Portland, Musselroe Wind Farm, northern end of Musselroe Bay, 40°48'36"S 148°06'44"E, 11.ix.2019, *G. Kantvilas* 240/19 (HO); Stony Head Training Area, Ryans Hill, SE of summit, 41°01'05"S 147°01'43"E, 210 m, 4.xi.2020, *G. Kantvilas* 195/20 (HO); Stony Head Training Area, Ryans Hill, 41°01'S 147°02'E, 50 m, 16.iii.2021, *G. Kantvilas* 301/21 (HO); Umtali, behind

Adams Beach, 40°59'S 147°22'E, 2 m, 10.ix.2021, G. Kantvilas 380/21 (HO); beyond end of Bolduans Road, 40°47'S 145°02'E, 1 m, 22.x.2021, G. Kantvilas 431/21 (HO); Woolnorth, "Paperbark Corner", 40°44'S 144°43'E, 15 m, 6.ii.2023, G. Kantvilas 69/23

(HO); King Island, Pennys Lagoon, 39°39'28"S 144°04'16"E, 14 m, 24.x.2023, G. Kantvilas 358/23 (HO); King Island, Collier Swamp Conservation Area, 40°05'47"S 143°58'41"E, 25 m, 26.x.2023, G. Kantvilas 413/23 (HO). **SOUTH AUSTRALIA:** Kangaroo Island,

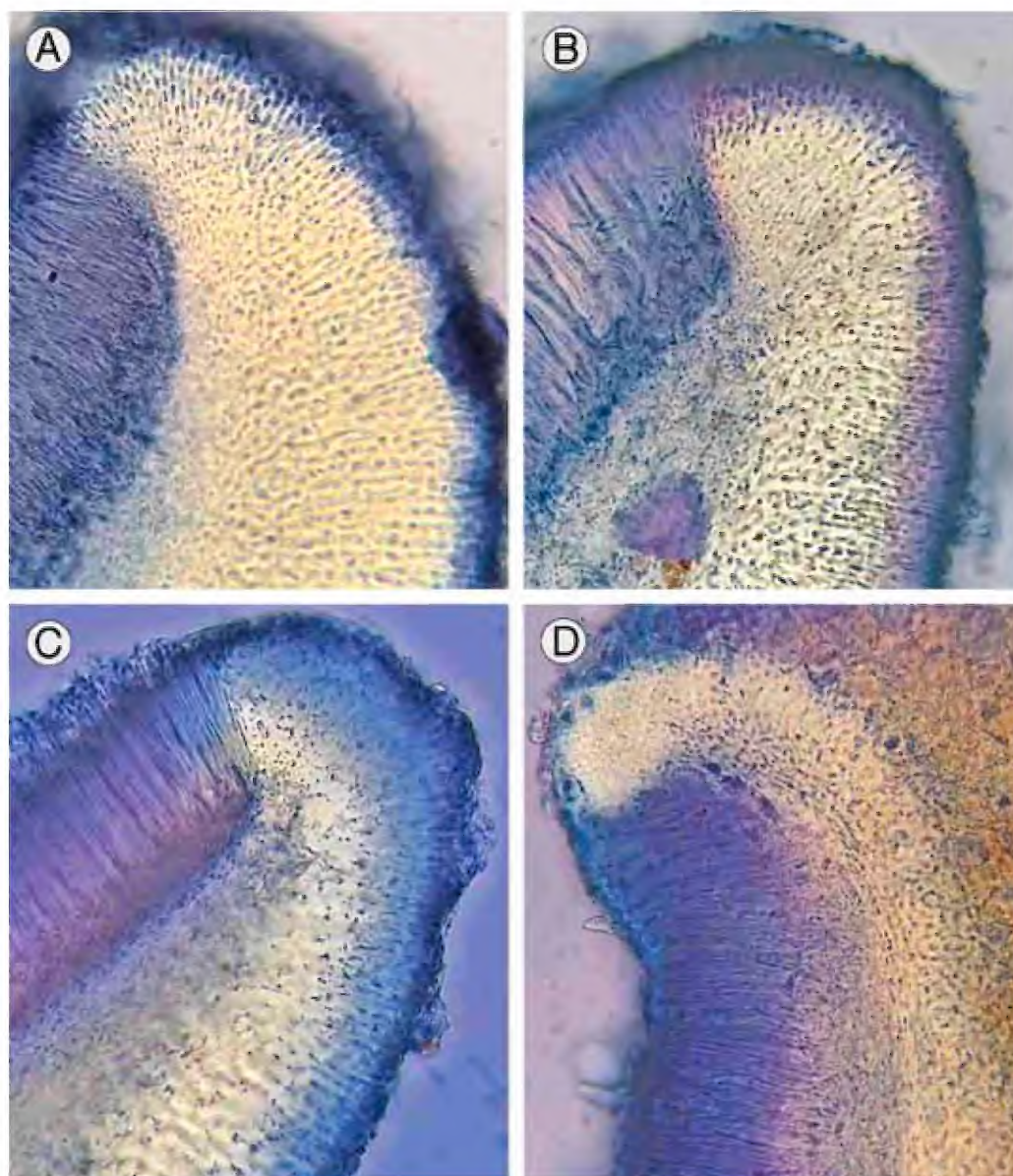


Figure 3. Transverse sections of apothecia, comparing excipular anatomy of *Coenogonium* (A–C) and *Gyalecta* (D), stained in Lactophenol Trypan Blue. **A:** *Coenogonium luteum* [Italy, D. Puntillo s.n. (A. Vězda: Lich. Sel. Exsicc. 24060 (HO))]: radiating hyphae with wide lumina, becoming parenchymatous towards the outer edge. **B:** *C. australiense* [Tasmania, Kantvilas 691/84 (holotype) (HO)]: similar anatomy to *C. luteum*, with hyphae with narrow lumina internally, radiating and becoming parenchymatous at the outer edge. **C:** *C. flavoinspersum* [Tasmania, Kantvilas 301/21 (holotype) (HO)], with internal hyphae with very narrow lumina, nevertheless radiating and becoming parenchymatous at the outer edge. **D:** *Gyalecta geoica* (type species of the genus) [Czech Republic, B. Bruna & A. Vězda s.n. (A. Vězda: Lich. Rar. Exsicc. 321) (HO)]: all hyphae with narrow lumina, tangentially arranged adjacent to the hypothecium and irregularly arranged elsewhere; the large cells at the outer edge belong to the photobiont. (Photos: M. Baker)

Pelican Lagoon Conservation Park, 35°48'S 137°48'E, 10 m, 7.x. 2015, G. Kantvilas 316/15 & B. de Villiers (AD, HO).

***Coenogonium dilucidum* (Kremp.) Kalb & Lücking**

In R. Lücking & K. Kalb, *Bot. Jahrb. Syst.* 122, 32 (2000); —*Lecidea diluta* Kremp., *J. Mus. Godeffroy* 1, 103 (1873); *Dimerella dilucidum* (Kremp.) R.Sant., *Symb. Bot. Upsal.* 12(1), 394 (1952).

Thallus crustose, epiphyllous, pale greenish grey, smooth, forming diffuse, rather discontinuous, very thin, irregular patches 1–2 mm wide; photobiont in $\pm$ dispersed chains of rectangular cells 8–15 $\times$ 5–7 μ m. *Apothecia* sessile, 0.12–0.26 mm wide; disc pale orange-pink, waxy and $\pm$ translucent, persistently plane; proper exciple persistent, a little paler than the disc, smooth and entire, in section 50–90 μ m thick, hyaline. *Hypothecium* to 20 μ m thick, hyaline. *Hymenium* 60–80 μ m thick, hyaline, l+ fleeting blue, soon yellow-brown, KI+ pale blue; paraphyses straight, simple, 1–1.5 μ m thick, with the apices swollen to 3–4 μ m and sometimes moniliform; asci 40–55 $\times$ 6–9 μ m. *Ascospores* oblique and uniseriate in the ascus, ellipsoid, 8–9.0–10 $\times$ 3–3.8–4.5 μ m; length to breadth ratio 2–2.4–2.9 ($n = 50$). *Pycnidia* not seen.

Remarks: The above description is based exclusively on the single Tasmanian specimen. Further descriptive data based on Neotropical material are provided by

Santesson (1952) and Lücking (2008). In the absence of pycnidia and their characteristic 1-septate, 14–18 $\times$ 2–2.5 μ m conidia (Lücking 2008), the identification of the single Tasmanian specimen is tentative. Nevertheless, with its tiny apothecia and relatively broad, short, ellipsoid ascospores, it matches herbarium material (determined and distributed by the respected specialist of foliicolous lichens, the late Antonin Vězda) of *C. dilucidum* perfectly. Both of the authors referred to above cite somewhat smaller ascospores (6–10 $\times$ 2.5–3 μ m in the case of Lücking (2008)) but the somewhat wider ascospores of the Tasmanian specimen are also seen in Vězda's exsiccatae.

This is a pantropical foliicolous species, similar to the equally widespread *C. subluteum* (Rehm) Kalb & Lücking which differs chiefly by having larger, darker orange apothecia (Lücking 2008). However, study of Vězda's exsiccatae suggests that this species also has somewhat longer ascospores, 11–13 $\times$ 4–4.5 μ m.

Coenogonium dilucidum is seemingly rare in Tasmania and was not recorded during a survey of Tasmanian foliicolous lichens (McCarthy *et al.* 2001). It has been collected just once, growing on a frond of the fern *Blechnum wattsii* in the understorey of rainforest of the thamnisc type (Jarman *et al.* 1994), dominated by the conifer *Athrotaxis selaginoides* over an understorey of the tall heath *Archeria serpyllifolia*. Its tiny apothecia are

Key to the Tasmanian species of *Coenogonium*

- | | | |
|------|--|----------------------------------|
| 1 | Thallus filamentous; filaments very densely woven, forming pannose cushions. | <i>C. implexum</i> |
| | Thallus crustose. | 2 |
| 2(1) | Apothecia mostly <0.5 mm wide. | 3 |
| | Apothecia >0.5 mm wide and often up to 2.5 mm wide. | 6 |
| 3(2) | Occurring on living leaves. | <i>C. dilucidum</i> |
| | Occurring on bark, wood or dead plant material, but never on living leaves. | 4 |
| 4(3) | Ascospores 3–4.5 μ m wide, strictly uniseriate in the ascus; apothecial disc light (yellowish) brown with a pinkish hue; margin cream. | <i>C. pineti</i> |
| | Ascospores mostly 2–3 μ m wide, uniseriate or irregularly biseriate; apothecia variously coloured. | 5 |
| 5(4) | Apothecia urceolate; disc orange with a pinkish hue; margin strongly prominent, cream or tending towards the colour of the disc but lighter. | <i>C. urceolatum</i> |
| | Apothecia plane; disc light (yellowish) brown with a pinkish hue; margin barely prominent, cream. | <i>C. lutescens</i> |
| 6(2) | Apothecial disc yellowish beige; margin cream; ascospores mostly 6–8 μ m long. | <i>C. atherospermatis</i> |
| | Apothecial disc orange with a pinkish hue; margin cream or tending towards the colour of the disc but lighter; ascospores mostly 8–16 μ m long. | 7 |
| 7(6) | Hypothecium and subhymenium densely interspersed with oil droplets to 5 μ m wide and yellow when freshly collected. | <i>C. flavoinspersum</i> |
| | Hypothecium and subhymenium not interspersed, or if interspersed then the oil droplets sparse, <3 μ m wide and hyaline. | 8 |
| 8(7) | Ascospores mostly 8–11 $\times$ 2.5–3.5 μ m. | <i>C. luteum</i> |
| | Ascospores mostly 10–14 $\times$ 3–4.5 μ m. | <i>C. australiense</i> |

arranged mainly along the veins on the upper surface of the host. Also present are the perithecia of *Porina blechnicola* Lücking *et al.* and *P. subapplanata* Malcolm *et al.*, as well as a species of *Fellhanera*. In Australia, *Coenogonium dilucidum* is also known from New South Wales (Vězda & Kalb 1991).

Follicolous species of *Coenogonium* are numerous and Lücking (2008) estimates that half of the known species of the genus grow on leaves. In Australia, these occur almost exclusively in Queensland (McCarthy 2023), with this report of *C. dilucidum* being the first of a foliicolous species from cool temperate latitudes.

Specimen examined: TASMANIA: Anthony Road, site W468, 41°50.5'S 145°37.5'E, 540 m, 12.xi.1992, J. Jarman s.n. (HO).

Comparative material examined: *Coenogonium dilucidum*: **BRAZIL:** Sao Paolo, Serra do Mar: Serra do Garraozinho, 850 m, 30.vi.1979, K. Kalb (HO). *Coenogonium subluteum*: **TANZANIA:** Morogoro Region, SE slope of Mt Kanga, 1200–1300 m, 30.iii.1998, E. Farkas 80110 (HO). **BRAZIL:** Sao Paolo, between Osasco and Cabréua, 750 m, 20.vii.1979, K. Kalb 169 (HO).

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